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ALTERNARIA CHRONOLOGY AND CATALOGUE RAISONNÉ Part I: 1796-1871

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ABSTRACT

All taxon names published in the period 1796-1871 that are known to bear on the classification of *Alternaria* species are discussed. Opinions are given on typification, uniqueness, and synonymy as well as compliance with the International Code of Botanical Nomenclature (ICBN). In addition, all names published in the nomenclaturally, often taxonomically overlapping genus *Macrosporium* during the same period are handled in the same manner, whether they have direct bearing on *Alternaria* taxonomy or not. Systematic disposition of 112 names of the period is attempted. The few new name combinations required for reasons of taxonomic opinion or ICBN rules include: *Clasterosporium caricinum*, *Alternaria instipitata*, *Thyrostromella heterospora*, *A. smyrnii*, *A. putrefaciens*, and *A. ulmi*.

All accepted taxa, and a few that are not, are treated in a concurrently published set of Simmons, *Alternaria Themes and Variations* (112-144), with extended discussion, technical descriptions, illustrations of type or other field specimens and of representative living cultures, when available, and group comparisons with similar taxa.

Introduction

Several factors have led to the following survey of names that have been, are, or should be associated with the genus *Alternaria* Nees : Fries (1816 : 1821).

One factor comprises the multitude of names, not only of the 19th century but also of more recent vintage, that

represent ill-defined "species"—the early ones because their original descriptions were poor and their types have disappeared or have not been analysed in modern times, the more recent ones chiefly because so many of them have been described without differential contrast with similar species or have been proposed on the basis of the muchabused "not previously reported on this host" approach. A house-cleaning of these several hundreds of names is essential to sustained progress in taxonomic revision of the genus and to increased precision of procedures for identifying its species.

Another relentless force arises from the increasing numbers of living *Alternaria* strains, isolated from innumerable substrates on a worldwide basis, that become available and warrant specific determinations. A high proportion of such materials crowds morphologically within a somewhat hazy popular concept of the generic type, *A. alternata* (Fries) Keissler (1912), and of a few somewhat similar species with chains of comparatively small (for this genus) to moderate-size conidia. It is true that we have little published guidance on species segregates in this broad group other than the exploratory and highly influential work of Neergaard (1945), the few selections made by M. B. Ellis (1971, 1976), and some portions of current studies by Simmons (1993, 1994). It also has become abundantly apparent, in this age of the one-conidium isolate grown under controlled conditions, that there are numerous different and stable patterns of sporulation and of individual conidium development within the *A. alternata* species-group (the "*A. tenuis* auct. sensu lato" of Neergaard), the *A. tenuissima* species-group, the *A. infectoria* species-group comprising *Alternaria* anamorphs of the pleosporaceous *Lewia* Barr & E. Simmons (Simmons 1986), and other species complexes. Stable segregates from these groups merit description and naming on the basis of distinctive living isolates.

In this step-by-step, chronologically ordered exploration of *Alternaria* species (and several that are not), comments are made on each published name, with attention to compliance with the *International Code of Botanical Nomenclature* (ICBN; Greuter et al. 1994, or other specified editions of the Code when pertinent), typification, uniqueness of species, and synonymy. In general, only published names that have been or, in my opinion, should be combined or synonymized in *Alternaria* are discussed. However, an attempt is made to dispose of all names published in *Macrosporium* Fries (1832), even when they do not represent *Alternaria*, for *Macrosporium* was for about a century the

impartial recipient of names of fungi now recognized as species of *Alternaria*, *Stemphylium*, *Ulocladium* and, to a minor extent, other dematiaceous genera.

Other conventions of reference adopted are:

: Whenever the treatment of a name and the taxon it represents requires illustrations or more than a few sentences of comment or comparison, the expanded material is presented as a numbered unit in the separate series of essays *Alternaria Themes and Variations* initiated and in continuation for this purpose (Simmons 1981-1995; Simmons and Roberts 1993). A device "Alt.T&V no. ..." is used for referring to these numbered units, whose places of publication are listed in *Literature Cited*.

: Institutional herbaria are cited by means of appropriate abbreviations, e.g., UPS, from the list compiled for *Index Herbariorum* (Holmgren et al. 1990).

: My own record/study numbers are cited whenever they are relevant. Each such number is unique to a specimen or isolate and to its derivative slide preparations, illustrations, related data, distributed cultures and herbarium deposits, and publications. Citation of an EGS number is a positive statement that I have examined or produced the associated material and am not simply quoting previous authors. The reference format used herein is, e. g., EGS 11-042, which signifies my record book no. 11, p. 42 (each book having 200 pages).

: Sections of text are presented in chronological order of publication of names, e.g., 1796 *Uredo bullata* Persoon. Within the text a device "Alt. Chronology[date]" is used to refer to the discussion of an associated taxon name in another section of the text, e.g., "Alt. Chronology 1796" serves as guide to the discussion under 1796 *Uredo bullata*. Each date used in such an internal reference also is included with its related author entry in *Literature Cited*.

: Short paragraphs of text introduced by a colon mark are related parts of series that share a common introductory paragraph or heading, e.g., this series of reference conventions, and infrequently, in the chronological text, a series of short entries whose brevity or degree of significance does not merit repetition of bibliographic data.

* * * * *

1796 *Uredo bullata* Persoon, Obs. Myc. I, p. 98.

Persoon's holotype specimen (L, no. 910,263-1168; EGS 11-042) bears a species of Urediniomycetes. Its name is listed here only because it entered the *Alternaria* literature in the form "*A. bullata*. Fr." (Alt. Chronology 1849) after having passed through several generic transfers and spelling transformations in the early 19th century. Related names, all obligately synonymous, include *Bullaria umbelliferarum* DC. (Alt. Chronology 1805), *Stilbospora bullata* (Pers.) Link (Alt. Chronology 1816), *Didymosporium bullatum* (Pers.) Fr. (Alt. Chronology 1832), and *Phragmotrichum bullaria* Corda (Alt. Chronology 1837). H. and P. Sydow (1902-1904) compiled most of the synonyms under *Puccinia bullata* (Pers.) Winter.

1801 *Uredo bullata* Pers. : Pers., Syn. Meth. Fung., p. 222. (nom. sanct.)

This is simply the compilation of the name in the Persoon sanctioning work (ICBN, Art. 13.1(d); Greuter et al. 1994) for this group of fungi: "22. *Uredo bullata*. . . Obs. myc. 1. p.98. t.2.f.5. et t.5.f.9."

1803 *Puccinia convallariae* Schumacher, Enum. Plant. Saell. II., p. 235.

This is the basionym of *Macrosporium convallariae* (Schum. : Fr.) Fr. (Alt. Chronology 1832), which possibly is an *Alternaria*, and just as likely is not. Wiltshire (1933), in his detailed review of the foundation species of *Alternaria* and *Macrosporium*, determined that there is no pertinent specimen in either the Schumacher herbarium at G or that of Fries at UPS. Having duplicated Wiltshire's search for such a specimen and expanded it with considerable search of my own for instructive types, illustrations, exsiccati, and literature, I conclude that the identity of the fungus represented by Schumacher's and Fries's binomials cannot be determined. The hopelessness of suggesting an application for some very early names (and sometimes modern ones) in the absence of type material is illustrated by Schumacher's description: "*Puccinia*. 1583. *Convallariae*, *sparsa*, *subcongesta*, *sporulis ovatis subrotundis brevissime stipitatis*. In *foliis Convallariae multiflorae*. Septemb." In addition, there exists no body of phytopathology information on *Convallaria* L. (Liliaceae) that would encourage us to neotypify Schumacher's fungus with a specimen of some orphan dematiaceous hyphomycete.

- 1805 *Bullaria umbelliferarum* DC., in J. de Lamarck and A. de Candolle, Flore Française, ed. 3, v. 2, p. 226.

This is a substitute name for *Uredo bullata* Pers. (Alt. Chronology 1801): "605. Bullaire des ombellifères. *Bullaria umbelliferarum*. *Uredo bullata* Pers. Syn. p. 222. Obs. Myc. 1. p. 98." Persoon's epithet must be retained.

- 1816 *Alternaria tenuis* Nees, Das System der Pilze und Schwämme, p. 72.

This original name for the type species of *Alternaria* Nees : Fr. is untenable because Fries cited it only as a synonym, "*Alternaria tenuis*. Nees!," when he published the substitute name *Torula alternata* Fr. (Alt. Chronology 1832) in the ICBN-defined sanctioning work that covers *Fungi caeteri* (Fries 1832). The correct name for this species in *Alternaria* is *A. alternata* (Fr.) Keissler (1912). See Simmons (1967) for a discussion of this genus typification and for a description of an authentic Nees specimen chosen as neotype (L, no. 910,262-129; EGS 11-050), which is annotated "*misit Nees in herb. Persoon*" and bears what is presumed to be a Nees manuscript label "*Alternaria tenuis mihi*." And see Alt.T&V nos. 73 & 115 for amplified discussion of this species, its representation in pure culture, and its segregation from other taxa of *Alternaria* with conidia of small or medium size.

- 1816 *Stilbospora bullata* (Pers.) Link, Magaz. Gesells. nat. Freunde zu Berlin 7: 30.

Simply a new combination for *Uredo bullata* Pers. (Alt. Chronology 1801): "*St.[ilbospora] bullata* . . . *Uredo bullata* Pers. *Bullaria umbelliferarum* Decand."

- 1818 *Alternaria rudis* Ehrenberg, Sylvae Mycol. Berol., pp. 10 & 22.

Fries made a new combination for this name in the genus *Torula* Pers., thus sanctioning *Torula rudis* (Ehrenb. : Fr.) Fr. (Alt. Chronology 1832). Type material of the species is of a black, crustose, wood-inhabiting fungus with variously swollen, thick-walled, phaeodictytic hyphal elements that are superficially alternarioid in appearance. An appropriate transfer to the genus *Peyronelia* Cif. & Gonz. Frag. has been made as *P. rudis* (Ehrenb.) S. Hughes (1958). Portions of the Ehrenberg material are held in several herbaria, including B, L, PC, STR, and UPS. Hughes did not choose a lectotype; the portion at B (EGS 09-093) is selected here for that purpose. Cfr. Alt.T&V no. 112.

- 1818 *Helmi[ntho]sporium tenuissimum* Kunze ex Nees & T. Nees, Verh. Leop.-Carol. Acad. Naturfors. I, Nova acta, 9: 242.

Typification of this name presents problems that are more easily discussed in the context of its sanctioning as *Macrosporium tenuissimum* (Nees & T. Nees : Fr.) Fr. (Alt. Chronology 1832), q.v.

In 1818 the Nees brothers provided valid publication of the name given to them by "Kunze in litteris." Other binomials based on this name are *Clasterosporium tenuissimum* (Nees & T. Nees) Sacc. (1886) and *Alternaria tenuissima* (Nees & T. Nees) Wiltshire (1933). It is of substantial taxonomic and application importance that the identity of this *Alternaria* species be defined and circumscribed, because the current rather diffuse popular concept of the species, paralleling that of *A. alternata*, covers a group of several morphologically distinct species.

See *Macrosporium tenuissimum* (Nees & T. Nees) Fr., Alt. Chronology 1832, for discussion of sanctioning and typification of the epithet. And cfr. Alt.T&V no. 116 for expanded discussion of the *A. tenuissima* species-group.

- 1822 *Conoplea eryngii* Pers., Mycol. Europ. I, p. 11.

The species of *Alternaria* introduced under this name is holotypified by a specimen in the Persoon herbarium (L, no. 910,263-1237; EGS 11-045). Several recombinations in other genera, all obligately synonymous, include *Exosporium eryngianum* Chev. (Alt. Chronology 1826), *Exosporium eryngii* (Pers.) Duby (Alt. Chronology 1830), *Helminthosporium eryngii* (Pers.) Fr. (Alt. Chronology 1832), and *Alternaria eryngii* (Pers.) S. Hughes & E. Simmons, in Hughes (1958). Cfr. Alt.T&V no. 114.

- 1826 *Exosporium eryngianum* Chevallier, Flore gén. Envir. Paris, p. 39.

The name is an avowed substitute without change of typification (therefore illegitimate) for *Conoplea eryngii* Pers. (Alt. Chronology 1822): "3. *E.[xosporium] eryngianum* N.[obis] . . . *Conoplea eryngii*. Pers. l.c." [l.c. = "Pers. mycol. europ. 1, p. 12"]; = *Alternaria eryngii* (Pers.) S. Hughes & E. Simmons, in S. Hughes (1958). Cfr. Alt.T&V no. 114.

- 1827 *Puccinia cheiri* T. G. Lestiboudois, Botanogr. Belg., p. 132.

I have not seen authentic Lestiboudois material. If the fungus is the same as *Helminthosporium cheiranthi* Lib. in Desm. (Alt. Chronology 1827), as Desmazières suggests in discussion (l.c.), the name *Puccinia cheiri* Lestib. never can gain nomenclatural standing other than as a synonym of the sanctioned *Macrosporium cheiranthi* (Lib.) Fr. (Alt. Chronology 1832). H. and P. Sydow (1902-1904) did not index *P. cheiri* in their monographic study of *Puccinia*.

1827 *Helminthosporium cheiranthi* Libert in Desm., Plantes Crypt. du Nord de la France, Fasc. V, no. 213.

The original material of this taxon, distributed in exsiccati with printed text, is present in several herbaria, including BPI, K, L and PC. The portion held at K (EGS 11-005) is in better condition than others and is chosen as lectotype. The name is sanctioned through *Macrosporium cheiranthi* (Lib.) Fr. (Alt. Chronology 1832). Desmazières (l.c.) commented in his description that "*L'Helminthosporium Cheiranthi, examiné superficiellement, a donné lieu au Puccinia Cheiri, Lestib.*," which seems a less than subtle way of suggesting that Lestiboudois could not tell the difference between a *Helminthosporium* and a *Puccinia*, and suggests to me that Lestiboudois and Desmazières, both publishing in Lille (and perhaps living and working there at the same time), had examined and discussed the same fungus but had disagreed on its taxonomic placement. The likelihood that the name *Puccinia cheiri* Lestib. ever will re-emerge to cause nomenclatural difficulties is extremely remote. The correct name for the fungus in *Alternaria* is *A. cheiranthi* (Lib.) Bolle (1924). Cfr. Alt.T&V no. 123.

1830 *Exosporium eryngii* (Pers.) Duby, Botan. Gallic., pars II, p. 882.

The Duby listing is simply a correction of the epithet to correspond with the original Persoon (Alt. Chronology 1822) spelling rather than with the later one, *eryngianum*, introduced unnecessarily by Chevallier (Alt. Chronology 1826): "*E.[xosporium] Eryngii. . . Conoplea Eryngii Pers. myc. I. p. 11.*" = *Alternaria eryngii* (Pers.) S. Hughes & E. Simmons, in Hughes (1958).

1831 *Septosporium atrum* Corda, in Sturm's Deutschl. Flora . . . III. Abt., Bd. 3, p. 33-34. Fig. 17.

Type material of this taxon has not been found. The fungus was described and illustrated as being phaeodictyosporic and occurring on dead herbaceous stems, as have so

many *Alternaria* species. A variety was published later, *S. atrum* var. *foliicolum* Corda (Alt. Chronology 1837), occurring on decaying leaves of some species of Asclepiadaceae. The conidia of both species and variety were illustrated as phaeodictytic, pedicellate [rostrate?], and oblong to claviform. The general appearance could be interpreted as alternarioid; it also could be interpreted otherwise. A satisfactory conclusion could be reached only if the manner of conidium production in the original material could be determined.

Whether or not *S. atrum*, the type species of *Septosporium* Corda (1831), is an *Alternaria* may never be determined. The modern concept of *Septosporium* derives from a wood and bark inhabiting species described later, *Septosporium bulbotrichum* Corda (Icon. Fung. 1:12. 1837). This latter species has been treated by S. J. Hughes (1958) and by M. B. Ellis (1961), both after examination of the type specimen at PR. But I find no evidence that *S. atrum*, the genus type, has been handled taxonomically in modern times or indeed that the type specimen is extant, which places the genus name itself in jeopardy until the typification of its type species is established.

1831 *Azosma helminthosporioides* Corda in Sturm's Deutschl. Flora . . . III. Abt., Bd. 3, p. 35-36. Fig. 18.

This type species of *Azosma* Corda (l.c.) was described and illustrated as having phaeodictyous wedge-shaped spores with one end rounded and the other tapered to a point. Fries's suggestion (1832, Index, p. 55), "*Azo[s]ma*. Corda *Helminthosporioides* C. (*Cladosp[orium]* herb.[*arum*] stat.)," is incompatible with the modern concept of *Cladosporium* as a genus of phragmosporous fungi. The type specimen of *Azosma* (on dry conifer needles) is not known to be extant, which leaves problematic the combination *Macrosporium helminthosporioides* (Corda) Saccardo & Traverso, in Saccardo (1911), in a genus (*Macrosporium* Fr.) that has harbored so many species now considered to belong in *Alternaria*.

1832 *Helminthosporium brassicicola* Schw. ("*brassicola*"), Trans. Amer. Phil. Soc., n.s., 4: 279.

The identity of this extremely widespread and commonly encountered parasite of Brassicaceae is understood well on the basis of type study and clarification by Wiltshire, as *Alternaria brassicicola* (Schw.) Wiltshire (1947), and of the comprehensive considerations of its morphology in culture, pathology, and physiology by Groves and Skolko

(1944, as *A. oleracea* Milbrath), by Neergaard (1945, as *A. circinans* (Berk. & Curt.) Bolle, revised to *A. oleracea* Milbr. in 1945, Addition [2 pp. of emendations issued separately]), and by Joly (1964, as *A. oleracea* Milbr.).

There are two pertinent preparations in the Schweinitz herbarium at PH. One is inscribed "*Helminthosporium brassicola* S [sic] / valde memoria Beth. in cella nostra," bears a sketch of two spores attached to a conidiophore, and consists of fungus growth on cabbage petioles. This is the specimen studied by Wiltshire previous to his publishing *Alternaria brassicicola* (Schw.) Wilts. comb. nov. (1947). This preparation is selected here as lectotype of *Helminthosporium brassi[ci]cola* Schw. (PH; EGS 05-167). The second preparation in herb. Schweinitz is inscribed "*Helminthosporium Brassicola* Schw. / 2632-15-Syn. Fung." and consists of scanty fungus material on a small piece of cabbage leaf glued to the label (EGS 05-168). The correct name of the species is *Alternaria brassicicola* (Schw.) Wiltshire. Cfr. *Alt.T&V* no. 132.

1832 *Botryosporium prorumpens* Schweinitz, Trans. Amer. Phil. Soc., n.s., 4: 306.

The original Schweinitz specimen associated with this name bears several different fungi. The collection itself has been subdivided over the years, with portions now held at least in BPI, herb. Michener; FH, herb. Curtis; K, herb. Berkeley; and PH, herb. Schweinitz.

The PH portion (EGS 12-085) bears numerous phaeodictyoconidia lying detached on the substrate. These are strikingly similar to *Alternaria* conidia. However, there is no readily apparent pore or identifiable site of attachment in the broadly rounded end of the spores, and the narrowly tapered end of each of the few conidia examined is fractured. The visible evidence is inadequate to support calling the fungus an *Alternaria*, although it may be.

Damon (1952) reported that a fungus in the BPI portion appeared to be "of the general type found in *Stemphylium*" and illustrated two spores that could belong to one of several different genera but not to *Stemphylium* Wallroth (1833; and see Simmons 1967, 1969). A few very scarce conidia I have found on the BPI portion (EGS 17-117) are *Alternaria* of a small-spored species-group.

The FH portion (EGS 38-026) bears some rare alternarioid elements similar to those of the PH portion, some conspicuous clumps of miscellaneous fungus spore skeletons

(presumably deposited by insects, and illustrated in a sketch on the herb. Curtis specimen label), and a moderately extensive group of prorumpent *Epicoccum* sporodochia (conidia also sketched on the label). I have not examined the K portion, but the records at IMI indicate that M. B. Ellis at some time had given the opinion that the fungus on the K portion is an *Epicoccum*.

Schweinitz described a fungus with rudimentary sporodochia arranged in two to several subconfluent series and bearing very dark fascicles of dark, compressed-globose, pedicellate spores, which he illustrated as being dictyospores. His description and illustration are consistent with the characters of *Epicoccum* Link, and the FH portion of his original specimen bears a good representative of that genus. This FH portion of the original collection is selected here as the lectotype of *Botryosporium prorumpens* Schw. (FH; EGS 38-026).

Monotypic *Botryosporium* Schw. (1832) is a later homonym of *Botryosporium* Corda (1831), whose own type, *B. difusum* (Alb. & Schw.) Corda, apparently is of a species unknown to us by this name in modern times. The genus name *Botryosporium* Schw. is illegitimate (ICBN Art. 53; Greuter et al. 1994); its type is a species of *Epicoccum*.

1832 *Clasterosporium caricinum* Schw., ("*Clasterisporium*"), Trans. Amer. Phil. Soc., n.s., 4: 300.

The identity of this dematiaceous fungus with hyphopodia and blastic phragmoconidia, of widespread occurrence on some species of *Carex*, is well known through studies and illustrations published by Wiltshire (1933) and M. B. Ellis (1958, 1971). It is not characterized further here as it is not alternarioid in any sense. However, Fries published the name *Macrosporium caricinum* Fries (1832) in the sanctioning *Systema Mycologicum* on the basis of a specimen sent to him by Schweinitz, presumably a portion of the original collection(s) also used by Schweinitz when publishing *Clasterosporium caricinum* Schw. Since I am attempting here to regularize the nomenclature and classification of all *Macrosporium* binomials, it is desirable to clarify the status of the Schweinitz and Fries names published for the same fungus and to establish its correct name within ICBN guidelines.

Precise typification of the name by choice of an extant specimen, as required by ICBN standards, never has been accomplished for this taxon. The Schweinitz herbarium at PH contains material attached to a slip of paper labeled

in Schweinitz's manuscript: "*Clasterisporium caricinum* Schw. / in foliis majoricum Caricum / Beth.[lehem] / 2998-1-Syn. Fung." (EGS 03-131). Also in the Schweinitz herbarium is a separate packet containing six small packets of material, each labeled by Schweinitz as "*Clasterisporium* Lvs *caricinum* Lvs in Foliis Caricum maj. Bethel." or in some minor variant of this inscription (EGS 03-132, 03-133). All of these specimen portions may be, but need not be, of a single collection; there is no packet evidence to prove the point. The material at PH carrying the "2998-1-Syn. Fung." notation is selected here as lectotype of the Schweinitz binomial.

A single specimen in the E. Fries herbarium is labeled "*Clasterisporium caricinum*, Schw! ex Herb. Schwein." (UPS; EGS 11-070). Fries indicated, in his description of *Macrosporium caricinum* Fries (1832), that he had seen dried material from Schweinitz ("v.s. Schweiniz [sic] comm.") but made no mention of the Schweinitz genus name and binomial on the specimen. This single specimen in the Fries herbarium at UPS is chosen as lectotype of *Macrosporium caricinum* Fries; it may be, but is not necessarily, an isotypic part of the lectotype of *Clasterisporium caricinum* Schw.

The name *Clasterosporium* Schw. is that of a genus quite distinct from any genus-level taxon in the Fries sanctioning volumes. Students of the group (Wiltshire 1933, M. B. Ellis 1971, S. J. Hughes 1958, and Simmons) are unanimous in this opinion as well as in the identity of the several specimen portions they have seen and the synonymy of the two 1832 binomials. The epithet "*caricinum* Schw." is untenable in the genus *Clasterosporium* when the epithet "*caricinum* Fr." of the sanctioned *Macrosporium caricinum* Fr. is combined in *Clasterosporium* Schw. See Alt. Chronology 1832 below for *Macrosporium caricinum* Fries.

1832 *Macrosporium caricinum* Fries, Syst. Mycol. 3: 375.
(nom. sanct.)

As noted above for *Clasterosporium caricinum* Schw., Fries described *M. caricinum* on the basis of a portion of a Schweinitz collection of *C. caricinum*, this latter name being the one that is used by most authors for this *Carex* parasite.

The fungus is not an *Alternaria* and merits no descriptive handling in the present context. However, there appears to be no published comment on the effect of ICBN "later starting points" and "sanctioning" publications on the choice of a correct name for the fungus if it is

maintained as a taxon in *Clasterosporium* Schw., as all students of the group do. With the lectotypification for the Schweinitz and the Fries binomials as given above, the epithet "*caricinum* Schw." becomes untenable against "*caricinum* Fr." if the latter is transferred to *Clasterosporium*.

The correct name of this taxon becomes *Clasterosporium caricinum* (Fr. : Fr.) E. Simmons, comb. nov.; basionym, *Macrosporium caricinum* Fr. [nom. sanct.], Syst. Mycol. 3: 375. 1832. Creation of such a later synonym or homonym, usually forbidden by ICBN rules, is based on the privileged status of names and species epithets in Fries's *Systema Mycologicum* (ICBN Art. 13, 53; Greuter et al. 1994) and on the need to have a defensibly correct binomial and citable authority for the taxon.

- 1832 *Macrosporium cheiranthi* (Lib. in Desm.: Fr.) Fr., Syst. Mycol. 3: 374. (nom. sanct.)
= *Helminthosporium cheiranthi* Libert in Desm. (Alt. Chronology 1827)

This type species of *Macrosporium* Fr. : Fr. (l.c., p. 373) is congeneric with the type species of *Alternaria* Nees : Fr. (1821), *A. alternata* (Fr.) Keissler. Its correct name in *Alternaria* is *A. cheiranthi* (Lib. in Desm. : Fr.) Bolle (1924). Cfr. Alt.T&V no. 123.

- 1832 *Macrosporium convallariae* (Schumacher : Fr.) Fries, Syst. Mycol. 3: 373. (nom. sanct.)
= *Puccinia convallariae* Schumacher (Alt. Chronology 1803)

Although Fries, in discussing this taxon, used terms associated today with *Alternaria* (spores obovate-clavate, becoming phaeodictyous), there is no guiding specimen left by either Schumacher or Fries and certainly nothing in the way of current usage of the name or species that merits conservation. The fungus is unknowable on the basis of the evidence available to us. See Alt. Chronology 1803.

- 1832 *Macrosporium tenuissimum* (Nees & T. Nees : Fr.) Fries, Syst. Mycol. 3:374. (nom. sanct.)
= *Helminthosporium tenuissimum* Kunze ex Nees & T. Nees (Alt. Chronology 1818)

This taxon, a typical *Alternaria*, *A. tenuissima* (Nees & T. Nees : Fr.) Wiltshire (1933), requires special attention in that, in my experience, it and several morphologically similar species constitute one of the most commonly encountered group of *Alternaria* species worldwide. This

taxon, along with members of the *A. alternata* group, the *A. infectoria* group, and other taxa with conidia of small to moderate size, characterize a large portion of the genus for most mycologists, pathologists, and other taxonomy clients.

Wiltshire's attempt (1933) to locate original Kunze material of this species was unsuccessful. A candidate for consideration as type specimen, labelled "*Helmisporium tenerum* Kunze" in herb. E. Fries at UPS, proved to be of an *Alternaria* that did not match Fries's description (1832). However, a Desmazières exsiccatum (1827: *Pl. Crypt. France* no. 212), found in several herbaria (G, K, UPS, etc.) and cited by Fries (l.c.), seemed to Wiltshire to fit Fries's intent reasonably well, and it is this specimen and Wiltshire's illustrations of its conidia that have influenced the species concept held by most publishing students of the genus (Neergaard 1945, Joly 1964, M. B. Ellis 1971, Simmons 1981, 1995).

Under ICBN articles prior to those adopted at the 14th International Botanical Congress, Sydney, 1981 (Voss et al. 1983), the Desmazières specimen could not, in a strict construction of the rules, simply be chosen to typify *Helminthosporium tenuissimum* in place of a Kunze collection. Wiltshire, however, described the Desmazières specimen as though it were the type when he proposed transfer of the epithet from *Macrosporium* to *Alternaria*. And most of us, knowing full well that Wiltshire quite possibly had the wrong fungus and that a day of reckoning with the ICBN was inevitable, followed his lead. Fear of such a *dies irae* has vanished, in that decisions made at the Sydney Congress (Voss et al. 1983, ICBN Art. 7.17), now slightly reworded (Greuter et al. 1994, ICBN Art. 7.8), permit typification through recognition of the holotype, by selection of a lectotype from the original collection, if available, or of a neotype, not only on the basis of the protologue of the sanctioning author but also of "anything associated with the name in that work."

On the basis of this background, I propose as neotype specimen of *Macrosporium tenuissimum* (Nees & T. Nees : Fr.) Fr. the portion of the specimen of Desmazières' *Flora Crypt. France* no. 212 (1827) at K (EGS 38-133). Several portions of this exsiccatum known to me bear material of the same *Alternaria* species as does the neotype, sometimes a second quite different species of *Alternaria* (*A. dianthi* Stevens & Hall), and a mixture of elements of *Cladosporium*, *Stemphylium*, and *Heterosporium* species (BPI, EGS 07-041; G, EGS 17-026; PC, EGS 12-060). The neotype at K yields

fungus elements that duplicate the appearance of Wiltshire's illustrations (1933, p. 141 and Pl. VII, fig. 10).

This typification permits us to continue using the name in the sense that has become well established over the past 60 years. Nonetheless, and to keep the record clear, it must be added that a Kunze specimen upon which the Nees brothers presumably based their description of *H. tenuissimum* is extant among portions of herb. Nees held at P. S. J. Hughes has lent me his slide preparation from this specimen (DAOM 59169; EGS 36-026), the label of which reads relevantly "*Helmisporium tenuissimum* m[ihi, i.e., Kunze] / Lips. [Leipzig] ad caules umbellat. / aestate." The fungus present is an *Alternaria*; in my opinion it is not the same species as that of the sanction-related neotype proposed above. If the pre-1981 (Sydney) ICBN guidelines on typification were still in force, I would feel compelled to maintain the Kunze specimen at P as holotype and proceed to redefine and find a name for the Desmazières fungus. Under the Sydney code revisions, current usage in line with Wiltshire's studies can be maintained for *Alternaria tenuissima*, thus clearing our sense of practicality if not that of self-reproach at such treatment of Kunze and his colleagues Nees. Cfr. *Alt.T&V* no. 116.

1832 *Helmisporium tenue* Kunze ex Fr., *Syst. Mycol.* 3: 374.

This is simply a catalogue entry by Fries, as a synonym under *Macrosporium tenuissimum*, for a name "*Helmisporium tenue*" provided by "Kunze! in Litt." It is possible that the associated specimen seen by Fries is one that still is held at UPS (EGS 11-090) with a label "*Helmisporium tenerum* Kz." Wiltshire (1933) discussed and illustrated the fungus present and concluded (as I do on the basis of re-examination of the specimen) that it is an *Alternaria*, that it does not fit Fries's description of *Macrosporium tenuissimum*, and that it belongs with the species complex we now refer to as the *A. alternata* group.

The name *Helmisporium tenue* Kunze never was published validly, exists only as a published synonym, and has no legitimate standing in the nomenclature of any species. At one time the related Kunze specimen needed to be considered as a candidate in the typification of *H. tenuissimum* Kunze ex Nees & T. Nees, as Wiltshire (1933) did, seemingly reluctantly. However, the necessity has disappeared with proposal of a neotype for *Macrosporium* (*Helminthosporium*) *tenuissimum* (Nees & T. Nees : Fr.) Fr. in accord with ICBN Art. 7.8 and 13.1(d) (Greuter et al. 1994), as I have done in the preceding discussion of that name.

- 1832 *Helminthosporium eryngii* (Pers. : Fr.) Fr., Syst. Mycol. 3: 361-362. (nom. sanct.)
 = *Conoplea eryngii* Pers. (Alt. Chronology 1822)

This is the final one of the several 19th century new combinations based on the 1822 Persoon name, which now is treated in *Alternaria* as *A. eryngii* (Pers. : Fr.) S. Hughes & E. Simmons, in Hughes (1958). Cfr. Alt.T&V no. 114.

- 1832 *Torula alternata* Fries, Syst. Mycol. 3: 500. (nom. sanct.)
 = *Alternaria tenuis* Nees (Alt. Chronology 1816)

Fries (l.c.) wrote "*T.[orula] alternata* . . . *Alternaria tenuis*. Nees! Syst. f. 68. . . (v.s.)." Fries's new name was a total and explicit substitute for that of Nees; moreover, Fries's symbol and abbreviation "! . . . (v.s.)" indicate that he had seen an authentic Nees specimen.

No edition of the ICBN since that for Brussels (Briquet et al. 1912), when later starting-point dates for nomenclature of fungi were introduced, has permitted the retention of the epithet of the name *Alternaria tenuis* Nees instead of the later, now sanctioned one of *Torula alternata* Fr. : Fr. Fries's epithet was transferred to *Alternaria*, in the format *A. alternata* (Fr.) Keissler (1912), in accord with the Brussels Code. No relevant specimen has been found by me in the Fries herbarium at UPS; and I am not aware of any published indication that anyone else has seen such a specimen since the time of Fries's notations.

The problems of protecting the genus name *Alternaria* Nees : Fr. for monographic purposes, of establishing the name of the type species, and of typifying the name have been discussed and solved through published actions that now seem to be generally accepted.

Briefly, a proposal by Simmons (1964) to conserve the genus name *Alternaria* Nees ex Wallroth (1833) against *Macrosporium* Fries (1832) was approved by the IAPT Committee for Fungi and Lichens 1964-1969 (Donk, 1968); this approval currently takes the form of the ICBN listing of *Nomina generica conservanda et rejicienda* (Greuter et al. 1994, p. 142). This action was intended to be, and remains, supportive of taxonomic needs; but the Committee pointed out at the time (1968) that the proposal was superfluous "because the correct date of the publication of *Alternaria* is 'Nees ex Fr. 1821'," i.e., as discussed by Fries on p. XLVI of his introduction to vol. I of the *Systema*. The current sanctioned form is *Alternaria* Nees : Fr. (1816 : 1821).

The name of the type species, *Alternaria alternata* (Fr.) Keissler, was neotypified formally on the basis of a specimen labeled "*Alternaria tenuis* mihi . . . misit Nees in herb. Persoon" (L, no. 910,262-129; EGS 11-050) when it was discussed and illustrated by Simmons (1967).

Lest someone, in a misguided interest in nomenclatural purity, insist that some taxonomic meaning must be assigned to Fries's listing of *Alternaria tenuis* (as a synonym) and the Nees specimen he presumably examined, let it be noted that as late as 1849, in his *Summa Vegetabilium Scandinaviae* (sect. post., p. 505), Fries was questioning the relationship ("*Incerta civis*") of *A. tenuis* to other *Alternaria* species and other genera, and maintaining (l.c., footnote p. 506) that conidia in Nees's own specimen of *A. tenuis* did not have muriform septation ("*In specim. Alternariae tenuis a Neesio ipso sporidia non cellulata!*").

The necessary precision of nomenclatural actions does not, however, help to establish with any great degree of usefulness the identity of *Alternaria alternata* in terms of its appearance in nature under even minor variations of environment; even less guidance is to be expected in linking type characters with ones seen in axenic cultures. Establishing the nature of a selection of isolates chosen to represent the type species in its strictest sense is the subject of *Alt.T&V* no. 115 and especially of the section of discussion (XV. The *Alternaria alternata* species-group) that immediately precedes it (Simmons 1995). Also see *Alt.T&V* no. 73.

- 1832 *Torula rudis* (Ehrenb. : Fr.) Fr., Syst. Mycol. 3: 500. (nom. sanct.)
 = *Alternaria rudis* Ehrenb. (*Alt. Chronology* 1818)

This taxon currently is treated in *Peyronelia* Cif. & Gonz. Frag. as *P. rudis* (Ehrenb. : Fr.) S. Hughes (1958). Cfr. *Alt.T&V* no. 112.

- 1832 *Didymosporium bullatum* (Pers. : Pers.) Fr., Syst. Mycol. 3: 487.
 = *Uredo bullata* Persoon (*Alt. Chronology* 1796)

In this place Fries made an additional attempt (after Link (*Alt. Chronology* 1816) and Candolle (*Alt. Chronology* 1805)) to cope with Persoon's fungus, which has two-celled spores in chains. Eventually he relied on the character of spore catenulation in making a transfer to *Alternaria bullata* (Pers.) Fr. (*Alt. Chronology* 1849). See *Alt. Chronology* 1796, above, for a summary of the different

names that have been applied to this rust fungus.

1836 *Macrosporium brassicae* Berkeley, in J. Smith's The English Flora. ed 2, 5(2): 339.

Wiltshire (1947) performed a fundamental service when he reviewed the published names and, to the extent possible, authentic specimens for all the *Alternaria* species known or suspected to be parasitic on *Brassica* hosts. The two most commonly encountered of these taxa are known correctly as *A. brassicae* (Berk.) Sacc. (1880) and *A. brassicicola* (Schw.) Wiltshire (1947). Wiltshire weighed the merits and disposed of some 18 names of various degrees of legitimacy thought to represent the relatively long-spored (up to 200-300 μ m long) *A. brassicae*, with its large, stout-beaked conidia, and of some 12 names considered to be related to a smaller-spored (up to about 120 μ m long), almost erostrate *A. brassicicola*. His publication must be read in its original detailed form to be appreciated.

Wiltshire's decisions on which name belongs with which fungus have by now accrued an aura of "current usage" that need not be tampered with; indeed, it should be strengthened, as I propose to do below in an act of neotypification.

Although Wiltshire's final name assignments remain supportable, he arrived at them in spite of misinterpreting Saccardo's (1880, 1886) taxonomic views on *A. brassicae*. Wiltshire's misunderstandings or omissions are pointed out in Simmons (1995) in a discussion section on *A. brassicae* that precedes *Alt.T&V* no. 135. The amplified discussion is used to add bibliographic items significant to understanding Saccardo on the large-spored taxon that we now call *A. brassicae*, items that Wiltshire did not mention but consideration of which would have gone far toward clarifying the extremely complex nomenclatural tangle that he faced.

No original Berkeley specimen of his "cabbage *Macrosporium*" is known to exist. Wiltshire searched for it at K and BM without success, and K has informed me that "Berkeley kept few, if any fungi described in English Flora 1836."

I have hoped to neotypify *Macrosporium brassicae* Berk. with a modern topotype collection from England that will have yielded stable isolates with good sporulation. The attempt has been unsuccessful, primarily because isolates from otherwise suitable specimens either became unstable, with poor sporulation, or failed to survive

freeze-dry conservation procedures in use 30 years ago.

Nevertheless, I have selected one specimen and a derivative slide mount to serve as the formal neotype of a name for which no specimen or illustration of the type author is known to exist. This specimen (IMI; EGS 17-167) is on a leaf of cabbage (*Brassica oleracea* L. var. *capitata* L.) from a farm field in Essex County, England, coll. 16 Oct. 1966 by E. G. Simmons about 100km. (as the spore flies) from Berkeley's type locality, King's Cliffe, Northamptonshire. See *Alt.T&V* no. 135.

1836 *Puccinia brassicae* Montagne, Ann. Sci. Nat., sér. 2, Bot., 6:30.

The lectotype of this name, chosen here (PC, herb. Montagne; EGS 09-197), is on decaying leaves of *Brassica oleracea* and consists of a very scanty population of conidia identifiable as *Alternaria brassicae* (Berk.) Sacc. Montagne's illustration and conidium length measurements (200-250µm) are good for *A. brassicae*. Montagne actually published the name as "*Puccinia? brassicae* Montag." His query was related not to the novelty of the species but to the appropriateness of including it in the genus *Puccinia*, for in discussion he introduced, but did not adopt, a genus name *Rhopalidium* for the fungus. Fries (1832, p. 516-517, footnote C) considered the fungus to be novel (on the basis of a Montagne specimen) but preferred to postpone gracing it with a name until another time (which is understandable in that the footnote appears only 10 pages before the end of the text of the *Systema*).

Fries (1849) described *Rhopalidium* Fr. & Mont., referring to his own 1832 footnote and Montagne's 1836 illustration. No species was named in Fries's treatment, and his reference to Montagne's publication does not automatically transfer the 1836 basionym to the new genus (ICBN, Art.33; Greuter et al. 1994). The non-typified genus name *Rhopalidium* is considered not to have been published validly.

Finally, Montagne (1856) published descriptions for *Rhopalidium* Mont. & Fr. and a single species name (actually an epithet transfer from *Puccinia brassicae* Mont.), *R. brassicae* Mont. & Fr., also citing the Montagne and Fries references given above. Wiltshire (1947) took care to establish the latest possible date for publication of *M. brassicae* Berk. (13 Feb. 1836) and the earliest possible one for *P. brassicae* Mont. (16 May 1836). The two names represent the same fungus species and are taxonomic syno-

nymy, with the date of the Berkeley epithet having priority and the correct name of the fungus in *Alternaria* remaining as *A. brassicae* (Berk.) Sacc. (1880). See *Alt.T&V* no. 135.

1837 Corda illustrated phaeodictyospores for several of the species he described in the first volume of his *Icones Fungorum* (1837). Some of these drawings exhibit the characters of *Alternaria* to an enticing extent, so an attempt has been made to locate and examine pertinent type specimens of the Corda names. This was made possible by loans from PR and, in some instances, by examination of slide preparations made and lent by S. J. Hughes (DAOM). None of the species for which a type was found has proved to be an *Alternaria*. A brief list of pertinent names and comments is included here as a service to anyone else who may feel inclined to search for early usable *Alternaria* types and epithets in Corda's 1837 published work.

: *Helminthosporium atrichum* Corda, l.c., p. 13, Pl. III, fig. 189. Type specimen not found. In spite of an alternarioid appearance of elements in the illustration, it is impossible to establish a generic, much less a specific identity for the fungus in the absence of a specimen.

: *Helminthosporium striaeforme* Corda, l.c., p. 13, Pl. III, fig. 188. The type specimen has not been found. Some of the illustrated conidia are obovate and phaeodictytic. The habitat, dead decorticated wood, suggests the possibility of *Ulocladium* for genus placement, but this speculation is idle in the absence of a specimen.

: *Phragmotrichum bullaria* Corda, l.c., p. 10, Pl. II, fig. 149. This is not one of Corda's problematic phaeodictyosporic species. Instead, the name is one of the many nomenclatural synonyms of *Puccinia bullata* (Pers.) Winter, discussed above under *Uredo bullata* Pers. (*Alt. Chronology* 1796). Corda's published name actually is illegitimate, being superfluous, in that Persoon's original epithet "*bullata*" was cited as a synonym by Corda.

: *Septosporium atrum* Corda var. *follicola* Corda ("*fo-liiculum*"), l.c., p. 12, Pl. III, fig. 175. The type specimen of this variety has not been found. Illustrated conidia are quite alternarioid in appearance. Further opinion is impossible without a specimen; and see *S. atrum* Corda ex Sturm (*Alt. Chronology* 1831) for comments on the vulnerability of the genus name *Septosporium* Corda ex Sturm, whose type is unknown but illustrations of which also suggest an alternarioid entity.

: *Septosporium bulbotrichum* Corda, l.c., p. 12, Pl. III, fig. 176. The holotype specimen at PR (EGS 38-134 ex DAOM 50194]) remains assigned to this name by both Hughes (1958) and Ellis (1961) without being synonymized or recombined in another genus. The fungus is as illustrated by Ellis (l.c.) and quite certainly is not an *Alternaria*; and see *S. atrum* Corda (*Alt. Chronology* 1831) on the problematic typification of the genus *Septosporium* Corda.

: *Soredospora graminis* Corda, l.c., p. 12, Pl. III, fig. 173. The holotype at PR (EGS 38-135 ex DAOM 50054) contains phaeodictytic elements of considerable diversity in size, shape, and degree of septation, but certainly not of an *Alternaria*. Hughes (1958) made a transfer to *Fumago graminis* (Corda) S. Hughes.

: *Sporidesmium elegans* Corda, l.c., p. 7, Pl. II, fig. 120. The finely drawn and aesthetically appealing illustrations are of a phaeodictyosporic fungus that, in the absence of a type, cannot be identified.

: *Sporidesmium polymorphum* Corda, l.c., p. 7, Pl. II, fig. 119. The holotype at PR (EGS 11-030) is of a phaeodictyosporic fungus on *Betula* wood; not an *Alternaria*. Hughes (1958) treated the name in synonymy with *Monodictys putredinis* (Wallr.) S. Hughes.

: *Sporidesmium pyriforme* Corda, l.c., p. 7, Pl. II, fig. 116. The holotype at PR (EGS 11-032) was illustrated by Corda as having both phragmo- and dictyosporous. No longitudinal septa have been seen in conidia in a slide preparation from type; definitely not an *Alternaria*. Hughes (1958) treated the name in synonymy with *Trichocladium opacum* (Corda) S. Hughes.

1838 *Mystrosporium stemphylium* Corda, *Icones Fung.* II, p. 13, Pl. X, fig. 61.

Type not found. The description and illustration of phaeodictyosporous could be of an *Alternaria* or a *Ulocladium*, scarcely of a *Stemphylium*. No determination is possible in the absence of a specimen.

1838 *Phragmotrichum lignicola* Corda ('*lignicolum*'), *Icones Fung.* II, p. 9, Pl. IX, fig. 46.

The name is considered here only because Fries later made the combination *Alternaria lignicola* (Corda) Fr. (*Alt. Chronology* 1849) in accord with his interpretation of *Alternaria* as a genus of entities having aerial chains of

swollen units separated from each other by constrictions or linear connectives. The holotype specimen at PR (EGS 12-122) on a *Salix* twig is not an *Alternaria*. It is treated by Hughes (1958) as *Truncatella angustata* (Pers.) Hughes.

1841 *Macrosporium concinnum* Berkeley, Ann. Mag. Nat. Hist. 6: 435.

Published as "*Macrosporium concinnum*, n. s. *Helminthosporium striaeforme*, Corda, fasc. 1. p. 13.," Berkeley's substitute name is nomenclaturally superfluous and therefore illegitimate and to be rejected (ICBN, Art. 52; Greuter et al., 1994). In the absence of the Corda type (see Alt. Chronology 1837), which automatically is the type of the Berkeley name, the fungus cannot be identified, even to genus, with any degree of certainty. No specimen has been located that can be considered Berkeley's, described as "on the decorticated twigs of an old hamper made of some species of ozier. Apethorpe, Sept. 1840."

1843 *Helminthosporium secalis* Fée, Mém. Soc. Mus. Hist. Nat. Strasbourg 3(3), mém. VV, p. 36.

Type material for this name has not been found. Fée's text description is too generalized for use. His illustration of conidia, quite good for the period in showing obclavate alternarioid elements with distinctly muriform septation, immediately suggests a small-spored *Alternaria* taxon. But when the illustration's conidium dimensions are calculated on the basis of the specified enlargement, the resulting size of about $120 \times 30 \mu\text{m}$ is remarkably large for conidia of the sort shown with only 5-6 transverse and 2-3 longitudinal septa. It is not surprising, then, that Saccardo and Traverso (1913) commented that, on the basis of Fée's illustrations, the species might be considered strongly as a variety of *Alternaria brassicae* (Berk.) Sacc.; however, they already had made a new combination *A. secalis* (Fée) Sacc. & Trav. (1911).

Other than being noted briefly by Joly (1964), the name has not been used in the literature. There already are too many guessing games in *Alternaria* species typifications; I can see no justification for trying to neotypify the name *Helminthosporium secalis* or to devise a concept for a species that, in essence, has had none for about 140 years. The taxon is unknowable in the absence of the original specimen.

1845 *Macrosporium pinguedinis* Berk., Hooker's Lond. J. Bot. 4: 309.

This name is based on one fungus of several found growing "on grass on which animal fat had been poured." Portions of the type gathering, "Ohio. No. 146. T. G. Lea, Esq.," have found their way to FH (EGS 08-041); K (chosen here as lectotype; EGS 11-018); PC (EGS 12-054, 12-055). Berkeley's illustration (l.c., Pl. XII, fig. 2) of lanceolate phaeodictyospores suggests *Alternaria*, but examination of the type reveals that the conidia are more nearly like those of *Peyronelia* Cif. & Gonz. Frag., or some other genus with elongate, blastic, phaeodictytic elements, but certainly not *Alternaria*. Cfr. *Alt.T&V* no. 113.

1845 *Macrosporium punctiforme* Berk., Hooker's Lond. J. Bot. 4: 309.

Berkeley described this species in terms of spores associated in "sori" and with a "stroma." A portion of the original specimen at K (chosen as lectotype, EGS 11-021) and another portion at FH (EGS 08-042) are from a collection "on dead stems of *Rubus occidentalis*. Ohio. No. 166. T. G. Lea, Esq." The material is meager and exasperating, but some small, scattered sporodochial masses were found with spores acceptable within Berkeley's description and illustration (l.c., Pl. XII, fig. 1): obovate, developing a few (2-4) transverse and 1-2 longitudinal or oblique septa. The fungus probably is a species of *Stigmina*. It is not an *Alternaria*.

1846 *Mystrosporium pyriforme* Desm., Plantes Crypt. Nord Fr., ed. 1, fasc. 30, no. 1494. [edit. in sched.]

Using the material in the Desmazières exsiccatum at K (EGS 37-164) as lectotype, this fungus on *Eryngium campentre* is the same species as *Conoplea eryngii* Pers. (*Alt. Chronology* 1822), the epithet of which has been combined in *Alternaria* as *A. eryngii* (Pers.) S. Hughes & E. Simmons, in Hughes (1958). Cfr. *Alt.T&V* no. 114.

1848 *Alternaria chartarum* Preuss, Bot. Zeit. 6:412. 1848a.

The Preuss holotype at B (EGS 17-056) is on poisoned flypaper. It was illustrated very helpfully later (1862, Tab. 49). Chain formation of phaeodictytic conidia, as drawn, fits a concept of *Alternaria* prevalent then and to a great extent now. Unfortunately, the conidia were illustrated as being ovate with a relatively broad base, i.e., alternarioid. Re-examination of the type reveals that the conidia actually are obovate with a narrowed, perforate base. These conidial characters are among those of the genus *Ulocladium*, to which the epithet has been transferred

as *U. chartarum* (Preuss) E. Simmons (1967).

1848 *Septosporium instipitatum* Preuss (1848b), in Sturm's Deutschl. Flora, III. Abt., Bd. 6, p. 23, Pl. 12.

The holotype of this species at B (EGS 17-053) is a phaeodictyosporic fungus on conifer wood, a field substrate that stretches the traditional boundaries of the *Alternaria* concept. Conidiophores are simple or 1-2-geniculate with an apical pigmented secession site, and the conidia in general are obovate with a basal pigmented site; the appearance is basically alternarioid. Both conidiophores and conidia have relatively thick dark walls and septa, which is somewhat unusual for the great majority of *Alternaria* taxa. Nevertheless, a similar species (cfr. *Alt. Chronology* 1867, *Helminthosporium smyrnii* Crouan), although appearing heavy and somewhat coarse in field material, passes through developmental stages of unexceptional wall and color density when grown in culture.

Including morphologically coarse species of this sort in *Alternaria* may abuse the traditional *A. alternata* concept of the genus; but the alternative is to establish a new genus for them, which I consider to be unjustifiable. This and a few other similar species, for which cultures are available, are discussed in *Alt.T&V* nos. 123-131 in a section on an *Alternaria cheiranthi* species-group. Meanwhile, *Alternaria instipitata* (Preuss) E. Simmons, comb. nov.; basionym *Septosporium instipitatum* Preuss (in Sturm's Deutschl. Flora, III. Abt., Bd. 6, p. 23, Pl. 12. 1848.). Cfr. *Alt.T&V* no. 124.

1849 *Alternaria bullata* (Pers.) Fr., Summa Veg. Scand., p. 505.

Fries lists "*A. bullata*. Fr. . . . Cord. I. f. 149. . . Bullar. Dec." The citations are to *Phragmotrichum bullaria* Corda (*Alt. Chronology* 1837) and to *Bullaria umbelliferarum* DC. (*Alt. Chronology* 1805), and thus indirectly to the basionym *Uredo bullata* Pers. (*Alt. Chronology* 1796), a species of *Puccinia*.

1849 *Alternaria lignicola* (Corda) Fr., Summa Veg. Scand., p. 505.

Fries lists "*A. lignicola* (Cord. II. f. 46)." The reference is to *Phragmotrichum lignicola* Corda (*Alt. Chronology* 1838), a synonym of *Truncatella angustata* (Pers.) S. Hughes (1958).

- 1849 *Macrosporium bulbotrichum* (Corda) Fr., *Summa Veg. Scand.*, p. 501.

Fries lists: "*M. bulbotrichum* . . . *Septosp. Cord. I. f. 176*." The reference is to *Septosporium bulbotrichum* Corda (*Alt. Chronology* 1837), a name still in use for a distinct species by M. B. Ellis (1961), q.v. for illustrations and modern interpretation of the holotype at PR (EGS 38-134 ex DAOM 50194]) that certainly is not related to *Alternaria*.

- 1849 *Stemphylium cordae* Fr., *Summa Veg. Scand.*, p. 506.

Fries lists "*S. Cordae. Fr. . . . Mystrosp. Cord. I. f. 61*." Correction of the Corda citation from [*Icones Fung.*] "*I. f. 61*" (= "*Fusarium strobilinum*") to *II. f. 61* leads to *Mystrosporium stemphylium* Corda (*Alt. Chronology* 1838), a name whose type appears to have been lost. This leaves us with the possibility that the Corda illustration of variously dictyoseptate conidia may represent an *Alternaria* or a *Ulocladium* but almost certainly not a *Stemphylium*, as these genera currently are understood. Fries's substitute name is superfluous and therefore illegitimate for purposes of nomenclature.

- 1849 *Stemphylium subtile* Fr., *Summa Veg. Scand.*, p. 506.

Fries lists "*S. subtile. Fr. . . . Helminthosp. Cord. I. f. 189*." The reference is to *Helminthosporium atrichum* Corda (*Alt. Chronology* 1837), a name whose type apparently is lost. The cited Corda illustration shows elements that appear somewhat alternarioid, but no stronger opinion is possible without a specimen. Fries's substitute name, being superfluous, is illegitimate for purposes of nomenclature.

- 1849 *Macrosporium boucerosiae* Durieu & Mont., in Durieu de Maisonneuve, *Explor. Sci. Algérie . . . Botan.*, I. *Cryptogamie*, livr. 7-17, p. 359.

The holotype packet at PC (herb. Durieu; EGS 10-004) bears a precise drawing of two *Alternaria* conidia, said by the author (l.c.) to be 50-60 x 15 μ m in size, with 4-5 transverse septa and (according to the packet sketch) one longitudinal septum in each of three of the central sections of each conidium. The dried scrap of host material ("epidermis" of *Boucerosia mumbyana*, *Asclepiadaceae*) now is practically devoid of visible fungous structures. Most of the few *Alternaria* conidia present in a slide preparation have remained collapsed; one conidium that has regained its

form in lactic acid matches the original size and septation descriptions exactly. No opinion more precise than "*Alternaria alternata?* species-group" is possible on the basis of this specimen. Joly (1964) listed the name as a synonym of *A. tenuissima*, his concept of *A. tenuissima* being, in general, of a species group with conidia smaller than those typical of the species. The Durieu and Montagne fungus has generated no species concept other than that of the type, which is meager and, for practical purposes, negligible.

1850 *Helminthosporium septosporium* Preuss in Rabenhorst, Klotzschii Herb. viv. mycol., Cent. XIV, no. 1371. [edit. in sched.]

This name, attributed to Preuss, was published originally in this place without a description; a nomen nudum, therefore invalid. See next two entries.

1851 *Helminthosporium septosporium* Preuss, Linnaea 24: 117.

The specimen bearing the lectotype of this name at B (a portion of Klotzsch, Herb. viv. mycol. 1371; EGS 09-091) has a phaeodictyosporic hyphomycete that Rabenhorst may have had in mind when he transferred nom. nud. *Helminthosporium septosporium* Preuss (*Alt. Chronology* 1850) to *Macrosporium* Fr. as *M. septosporium* (Preuss) Rabenh. (*Alt. Chronology* 1851), which is the reason for including the taxon in this discussion. The fungus is a *Ulocladium*, *U. septosporium* (Preuss) E. Simmons (1967). It may be noted in passing that the type species of *Ulocladium* Preuss, *U. botrytis* Preuss (holotype B; EGS 17-051), was published in the same year as was *H. septosporium* Preuss but in a different place (1851, Preuss, in Sturm's Deutschlands Flora).

1851 *Macrosporium septosporium* (Preuss) Rabenh., Bot. Zeit. 9: 454.

Although the name combination *Macrosporium septosporum* [sic] (Pr.) Rabenh. has been attributed to Rabenhorst (Saccardo, 1886), it has aspects of invalidity. Rabenhorst proposed a combination (using '*septosporium*') with reference to the invalid name he had published in 1850 (l.c. supra); at the same time he provided a description for the cited nomen nudum. He did not refer to Preuss's 1851 (l.c. supra) publication of the basionym and description. In any case, the correct name of the fungus is *Ulocladium septosporium* (Preuss) E. Simmons (1967).

1851 *Macrosporium divisum* Bonorden, Handb. allgem. Mykol., p. 85, Taf. VIII, f. 175.

No specimen related to this name has been located. Bonorden's very good illustration shows conidia with 2-3 branches that are transversely septate; the branches have a common basal cell at the apex of an erect conidiophore. This organism need not be considered further in the *Macrosporium*/*Alternaria* context, as it has the attributes of a species of *Ceratosporella* Höhnelt.

- 1851 *Macrosporium torulosum* [Bonorden], Handb. allgem. Mykol., Taf. V., f. 123; p. 329 [legend].

Bonorden illustrated a fungus with phaeodictyic conidia solitary and terminal on erect conidiophores. Neither the legend for the figure nor the name with the figures carries an author's name, and the species is not mentioned in the text for this genus (p. 85). The name is without type specimen, description, and acknowledged parentage and need not be considered further for classification purposes.

- 1851 *Sporidesmium fuscum* Bonorden, Handb. allgem. Mykol., p. 48, Taf. II, f. 43.

No Bonorden specimen is known for this name. Two of the four spores illustrated could be of an *Alternaria* or possibly of a *Ulocladium*. No opinion more definite is possible.

- 1852 *Macrosporium heterosporum* Desm., Ann. Sci. Nat., sér. 3, Bot., 18: 358.

F. von Höhnelt (1919) synonymized *M. heterosporum* Desm. with *Sporidesmium myrianum* Desm. (1852) when he published "*Thyrostromella myriana* (D.) v. H. n. G." A specimen of *M. heterosporum* at PC (herb. Desmazières; EGS 12-049), chosen here as lectotype, is Desmazières' own portion of his exsiccata *Plantes Cryptogames du Nord de la France* (1853; ed. 2, sér. 2, fasc. 1, no. 8); another unit of this exsiccatum at NY (EGS 03-059) is in better condition than the lectotype. The fungus of this gathering is congeneric with a pertinent specimen of [*Thyrostromella*] *Sporidesmium myrianum* Desm. at PC (herb. Desm.; EGS 09-191), chosen here as its lectotype, but not conspecific with it. (Hughes, 1955, based a discussion of *T. myriana* on a portion of the "type collection of *Sporidesmium myrianum*" at NY, Desmazières Pl. Crypt. Nord France 2, but did not lectotypify the name. The fungus illustrated by Hughes appears identical with that in the lectotype at PC.)

It is appropriate to have two different names for these two related but different fungi, hence: *Thyrostro-*

mella myriana (Desm.) Höhnelt and *Thyrostromella heterospora* (Desm.) E. Simmons, comb. nov.; basionym: *Macrosporium heterosporum* Desm. (Ann. Sci. Nat., sér. 3, Bot., 18: 358. 1852.). Cfr. *Alt.T&V* no. 141.

1852 *Septosporium bifurcum* Fres., Beitr. zur Mykol. II, p. 48, Taf. VI, f. 1-8.

Type material for this name has not been found. The illustrations of solitary phaeodictyospores 18-35 μ m in length, the habitat (a wooden plank lying on marshy soil), and the original description suggest *Ulocladium* Preuss as an appropriate genus assignment. Fresenius himself compared his fungus with the illustration of *U. botrytis* Preuss known to him. Saccardo transferred the epithet to *Macrosporium*, giving *M. bifurcum* (Fres.) Sacc. (1886), which is the only reason for including the name in this discussion. No further opinion is justifiable in the absence of the original specimen.

1852 *Septosporium myrmecophilum* Fres., Beitr. zur Mykol. II, p. 49, Taf. VI, f. 29-32.

Type material has not been found for this name. The Fresenius drawing of solitary phaeodictyospores 12-20 μ m long, the habitat (the surface of an ant nest constructed of conifer-wood fibers), and the original description suggest the possibility of a *Ulocladium*; but this is only guesswork in the absence of a specimen. The name is included here in discussion because Saccardo transferred the epithet to *Macrosporium* as *M. myrmecophilum* (Fres.) Sacc. (1886).

1853 *Macrosporium heteronemum* Desm., Ann. Sci. Nat., sér. 3, Bot., 20: 216.

A collection of dead or dying leaves of *Sagittaria sagittifolia* L. with diseased spots scattered in the leaf blades was distributed by Desmazières in his exsiccata Pl. Crypt. Fr. (1853; ed. 2, sér. 2, fasc. 1, no. 7). Desmazières' portion of this collection at PC (herb. Desm.; EGS 12-048) serves as lectotype of *M. heteronemum*; other units of the type exsiccatum have been studied at NY (EGS 05-115) and BPI (EGS 07-040).

Desmazières' description is, for the most part, of the conidiophores and conidia of a *Cercospora* whose tiny erumpent pustules occur in great numbers in the leaf spots. His description includes observations on dark, oblong-clavate, septate-muriform (3-7 transverse septa), beaked

spores up to $60\mu\text{m}$ in length. These spores were said to be attached near the base of the clustered (*Cercospora*) conidiophores. Desmazières' species concept, then, was of dark muriform conidia (an *Alternaria*) arising in the base of fascicles of dark threads that produce fascicles of hyaline threads at their tips (the "*heteronemum*" of his epithet, but actually bundles of conidiophores and great numbers of long, narrow conidia of a *Cercospora*).

The name is based on elements of two very different fungi. It would be possible to select the *Alternaria* element and make some attempt to treat it taxonomically, but such an action would be without merit. Presumably Desmazières originally found enough muriform conidia to guide his observations; however, I have found a total of only 2-3 unquestionably alternarioid conidia after intensive search of three parts of the distributed exsiccata, so few that they might as likely have floated in from the air as to have been borne on the leaves. The specimens are worthless from a *Macrosporium/Alternaria* taxonomic viewpoint; and the name, lacking the support of any sort of modern species concept, should be allowed to fall into total disuse without any attempt at selectotypification. Precisely the same conclusion was reached by Höhnelt (1909).

1853 *Septosporium conjunctum* Preuss, *Linnaea* 25: 726.

The holotype of this name at B (EGS 17-052) is an *Alternaria*, which occurs on the specimen in conjunction with a *Stemphylium*, a *Helminthosporium*, and other easily differentiated moulds. The substrate, branchlets of *Fraxinus* ("*ramulis Fraxini dejectis*"), is so fragile as to have the texture of an herbaceous stalk, which could explain the presence of a taxon mixture seldom found on woody tissue.

Preuss's description of the conidia of this taxon is categorical: spores large, ovate, long-pedicellate, pedicels heterogeneous, filiform, attenuate [many authors of the 19th century and some of the 20th considered the conidial beak in *Alternaria* to be a basal stalk or pedicel; reinterpretation, when necessary, can be made when the actual specimens are examined]. *Alternaria* conidia of this description are abundant on the specimen; there is no reason to confuse them with the conidia of other fungi present, and it seems certain that Preuss did not. The fungus is a member of the *A. tenuissima* species-group, indistinguishable from *A. tenuissima* (Nees & Nees) Wiltshire on the basis of this material.

- 1854 *Sporidesmium septorioides* Westend., Bull. Acad. Roy. Sci. . . . Belgique 21: 236, f. 4 (in Pl. opp. p. 246).

The specimen of "*Reseda odorata*" leaves ("*Reseda lutea*" in type description) bearing the type of this name was distributed as no. 862 in the exsiccata of G. D. Westendorp and A. C. F. Wallays, *Herbier Cryptogamique* . . . Belgique (1854). The unit at BR (EGS 08-110), selected as lectotype, and another portion at NY (EGS 16-109) are of a distinctive species of *Alternaria*. Westendorp's type description and illustrations are appropriate to his material, with the exception that he drew conidia as though they were attached by their beaks. Conidia of the type are indistinguishable from those of *A. brassicicola* (Schw.) Wiltshire. Cfr. *Alt.T&V* no. 132.

- 1855 *Macrosporium obtusum* Berkeley, ex J. D. Hooker, Bot. Antarct. Voyage H. M. Discovery . . . II. Flora Novae-zelandiae, Pt. II, p. 198.

No specimen has been found in support of this name. Clavate, obtuse, 4-5-celled spores about 34 μ m long were said to occur on the ostioles of a *Hypoxyton* sent from New Zealand by Colenso. Colleagues at K have been unable to trace either the *Macrosporium* or a New Zealand *Hypoxyton* collection marked as bearing a *Macrosporium*. No illustrations were provided by Berkeley, so it is impossible even to guess at the identity of the fungus.

- 1855 *Sporidesmium exitiosum* Kühn, Hedwigia 1: 91, Taf. XII-B, f. 1-22.; with f. *alternarioides* and f. *luxuriosum*.

J. Kühn wrote at considerable length (l.c., pp. 86-91) and illustrated precisely and excellently the dark-spored fungous growth associated with a destructive disease of forage rape, *Brassica rapa* L. He expanded his discussion later and added to the illustrations (1856). Kühn's original gathering was distributed by Rabenhorst in the exsiccata *Klotzschii Herb. Viv. Mycol.*, ed. nova, Cent. II, no. 181 (1855) under the name *Polydesmus exitiosus* (Kühn) Rabenh. A portion of the collection at B (EGS 10-094) with manuscript notes the same as the description published by Kühn, is, as nearly as I can determine, devoid of conidia referable to the original description and drawings of an alternarioid fungus. It would be a distortion of the value of typification to choose the exsiccatum unit at B as lectotype, the type of a fungus name being a fungus, not just some barren plant parts. The portions of the Raben-

horst exsiccata I have examined at BPI (EGS 07-051) and FH (EGS 07-176) are no better and cannot serve as lectotypes.

A portion of the Rabenhorst exsiccata at K (EGS 37-165) has yielded conidia that match the description and illustration of *S. exitiosum* (but not of the formae); this holding at K is designated lectotype of the species name.

With a knowledge of the kinds of dematiaceous moulds that commonly attack *Brassica* leaves, it is easy to suggest the identities of two species of *Alternaria* in Kühn's illustrations: the very large-spored, occasionally short-chained *A. brassicae* (Berk.) Sacc. (1880) and the smaller-spored, typically long-chained *A. brassicicola* (Schw.) Wiltshire (1947). It is my interpretation of Kühn's original extensive discussion that he considered the several growth forms intermixed on the host to be different sporulation conditions of a single fungus, with the forma *alternarioides* being simply a small-spored form arising in chains directly from the substrate and the forma *luxuriosum* the same spore form except that sporulation was on delicate aerial hyphae arising from the substrate.

Wiltshire (1947) synonymized *Sporidesmium exitiosum* with *A. brassicae* and the two small-spored forms with *A. brassicicola*, apparently on the basis of Kühn's illustrations, for he gives no evidence of having examined Kühn specimens. I agree entirely with his conclusions, using the K lectotype as support for the *A. brassicae* synonymy. Cfr. *Alt.T&V* no. 135.

No portion of any Kühn specimen that I have examined has yielded conidia recognizable as his "*f. alternarioides*" and "*f. luxuriosum*." Basing an opinion on Kühn's illustrations (l.c.) of these formae, the form names are considered to be synonyms of *A. brassicicola* (Schw.) Wiltshire. Cfr. *Alt.T&V* no. 132.

1855 *Sporidesmium exitiosum* Kühn var. *dauci* Kühn, Hedwigia 1:91, Taf. XII-C, f. 1-18.

Kühn described a fungus and a related disease of carrot foliage at the same time that he discussed the brassicicolous *S. exitiosum* Kühn (*Alt. Chronology* 1855, above). In describing the carrot pathogen as a variety *dauci* of *S. exitiosum*, he differentiated conidia of these two large-spored dematiaceous moulds primarily on the character of the spore apex: tapering broadly to a blunt point in *S. exitiosum* (= *A. brassicae*), but tapering into a long thin, narrow appendage in *S. exitiosum* var. *dauci*.

Kühn's specimen accompanied by his manuscript notes at B (EGS 10-095) is chosen as lectotype of the variety; the material is excellent, with abundant conidia of a distinctive *Alternaria* now known correctly as *A. dauci* (Kühn) Groves & Skolko (1944). The type gathering was distributed by Rabenhorst in his *Klotzschii Herb. Viv. Mycol.*, ed. nova, Cent. II. no. 182 (1855) under the name *Polydesmus exitiosus* (Kühn) Rabenh. var. *dauci* Kühn; other excellent portions of the type gathering are at BPI (EGS 07-052) and FH (EGS 07-177). Cfr. *Alt.T&V* no. 142.

1855 *Polydesmus exitiosus* (Kühn) Rabenh., in *Klotzschii Herb. Viv. Mycol.*, ed. nova, Cent. II, no. 181.

The name combination was derived, without explanation or discussion, from "*Sporidesmium exitiosum* Kühn in *Hedw. N.13 T.XII.B* [*Alt. Chronology* 1855] *Una cum formis Alternarioides et luxuriosus . . . leg. J. Kühn.*" This number of the Rabenhorst exsiccata comprises portions of Kühn's original collection of *S. exitiosum*. Cfr. *Alt.T&V* no. 135.

1855 *Polydesmus exitiosus* (Kühn) Rabenh. var. *dauci* Kühn, in Rabenhorst, *Klotzschii Herb. Viv. Mycol.*, ed. nova, Cent. II, no. 182.

This transfer of Kühn's var. *dauci* was made in consequence of the transfer of *Sporidesmium exitiosum* Kühn (*Alt. Chronology* 1855) to *Polydesmus* in a new combination. Cfr. *Alt.T&V* no. 142.

1855 *Mystrosporium aterrimum* Berk. & M. A. Curtis, in Ravenel, *Fungi Caroliniani*, fasc. IV, no. 86.

The exsiccatum label reads ". . . *ad stipites emortuos Smilacis. Ex Pennsylvania misit Michener.*" Part of the original specimen associated with this name, which is a nomen nudum in this initial place of publication, is at BPI (EGS 07-136). A better specimen, which almost certainly is part of the original gathering, is at FH (herb. Curtis; EGS 08-045) and is accompanied by spore sketches and notes "(3765.) *Mystrosporium aterrimum*, B. & C., in *Smilace rotundif. Penna. 1851. Dr. Michener* (607)."

M. C. Cooke (1877, *On Black Moulds*) used the name with reference to his illustration (l.c., Pl. 26, f. 18) of some dematiaceous, clavate phragmospores about 60 μ m long, attached in clumps to the substrate by their narrow ends. No description or other mention of this species appears in Cooke's paper, where the name remains a nomen nudum.

Saccardo (1886) attached a description to the name, citing only the reference "*Cooke Black Moulds* t.26, f.18," which is to the M. C. Cooke 1877 illustration mentioned above. Saccardo's description obviously was concocted from the Cooke drawings, with the difference that Saccardo spoke of "*conidiis . . . muriformibus*." The character "*muriform conidia*," as used in the 19th century, triggers a suspicion that an *Alternaria* species might be involved, hence the inclusion of this fungus in these studies.

It becomes apparent, on examination of the excellent material at FH, that Cooke drew the conidia attached by the wrong end and that Saccardo compounded errors by adding longitudinal septa that Cooke had not illustrated and that, in fact, do not occur in the conidia of this fungus. The legitimacy of the name based on the Michener specimen dates from Saccardo's publication of a description, however much in error; thus, *Myrothecium aterrimum* Berk. & M. A. Curtis ex Sacc. (1886). The portion of the original specimen at FH, specified above, is selected as lectotype of the name. The fungus is a species of *Sporidesmium*, quite similar to *S. flagellatum* (S. Hughes) M. B. Ellis (1958).

1856 *Rhopalidium brassicae* (Mont.) Mont. & Fr., in Montagne, Syll. Gen. Spec. Cryptogam., p. 297.

The genus *Rhopalidium* Mont. & Fr. was published (l.c.) with a single species *R. brassicae* and pertinent references to the original publication and illustration of *Puccinia brassicae* Mont. (Alt. Chronology 1836). There also is a reference to Fries's *Summa Veg. Scand.*, p. 476 (1849), where Fries had published *Rhopalidium* Fr. & Mont. invalidly. See Alt. Chronology 1836 for discussion of these names. The fungus in the lectotype of this species at PC (herb. Montagne; EGS 09-197) is identifiable as *Alternaria brassicae* (Berk.) Sacc. The genus name *Rhopalidium* Mont. & Fr. is a taxonomic synonym of *Alternaria* Nees : Fries. Cfr. Alt. T&V no. 135.

1857 *Macrosporium cladosporioides* Desm., Bull. Soc. Bot. Fr. 4: 799.

Type material ("*in foliis languescentibus Betae vulgaris*") for this name is reported not to be found in the Desmazières herbarium at PC.; searches in numerous other herbaria have not revealed any specimen that might have type value. The name often appears on specimens in major herbaria and in published reports of miscellaneous identifications. Unfortunately, there has been no congruence of interpretations of the species by the several identifiers.

Desmazières gave no illustrations of the spores described as subpellucid, sometimes torulose, unequal [inequilateral? variable in size?], 2-3-multicelled, ovoid, oblong to elongate, clavate, narrowly pedicellate. Each subsequent identifier who used the name appears to have selected whatever type-description term suited material at hand when making a determination; the several opinions, judging from pertinent specimens, rarely, possibly never, coincide.

In order to make a point that there is no established species concept for this rather commonly listed name, for which no original collection is known, the following comments are made on specimens distributed under this name in exsiccata or deposited in herbaria by some of the more noteworthy collectors:

- : Bubák, F. (BKL; EGS 03-178) on *Asphodelus*, Montenegro, 1903; a *Stemphylium*.
- : Bubák, F. (BKL; EGS 03-177) on *Ricinus*, Spain [1914, 1917 or 1919?; ms illegible]; a mixture of *Cladosporium* and a *Stemphylium* quite distinct from that in the collection on *Asphodelus*.
- : Cooke, M. C. (NY; EGS 05-030) on *Arctium*, UK, 1874; an *Alternaria*.
- : Ellis, J. B. (NY; EGS 05-034 & 05-036) #2529 on *Phytolacca*, NJ, USA, 1877; a mixture of *Alternaria tenuissima* sp.-grp., *Cladosporium*, and *Stemphylium*.
- : Ellis, J. B. (NY; EGS 05-037) #2767 on *Lactuca*, NJ, USA [n. d.]; mostly *Stemphylium* plus some conidia of a small-spored *Alternaria*.
- : Hariot, P. (PC; EGS 10-002 & 10-003) on *Allium* leaf and scape, France, 1889; mostly a *Stemphylium*, plus spores of miscellaneous other moulds.
- : Sydow, P. (WIS; EGS 01-185) Mycoth. germ. 2045, on *Chenopodium*, Germany, 1921; an *Alternaria* of the *A. tenuissima* sp.-grp., plus heavy intermixture of *Cladosporium*.
- : Weber, G. F. (NY; EGS 05-028) on *Lactuca*, FL, USA, 1923; a *Stemphylium* plus a *Cladosporium*.

The observation that surprises me most in this listing is that so many of the specimens have a *Stemphylium* component. Saccardo (1886), in compiling the species description, remarked that conidia apparently are not muriform and that placement in *Macrosporium* was questionable. The only pictorial clue I have found that would help to explain the situation, if the *Stemphylium* components are other than coincidental, is an illustration of solitary, non-beaked dictyospores for a Westendorp (1863) listing of *M. cladosporioides* intermixed with "*Sphaeria*

herbarum var. *tectum* Fr." (a *Pleospora*, if the determination was generically correct) on stalks of cultivated onion. Even with such a fairly commonly held generic concept of *Stemphylium* embedded in this name, there is no positive clue to the identity of the Desmazières type; and it needs to be remarked that the *Stemphylium* components of the several specimens (none of them on *Beta vulgaris*, the type substrate) represent at least three different species of the genus.

The fungus represented by the name *Macrosporium cladosporioides* Desm. is considered unknowable on the basis of the evidence available to us. Neotypification of the name would be purely guesswork and would serve no purpose other than possibly to dislodge some other name with better credentials. The name *Macrosporium cladosporioides* Desm. should be dropped from use and consideration in the taxonomy of hyphomycetes unless original Desmazières material is discovered.

1858 *Polydesmus exitiosus* Kühn [sic], Die Krankheiten der Kulturgewächse, p. 165 (with forma *alternarioides* and forma *luxuriosum*)

This name duplicates the epithet transfer made by Rabenhorst as *P. exitiosus* (Kühn) Rabenhorst (Alt. Chronology 1855) and is superfluous.

1858 *Polydesmus exitiosus* Kühn [sic] var. *dauci* Kühn, Die Krankh. der Kultergewächse, p. 165.

This name duplicates the handling of the variety epithet by Rabenhorst as *P. exitiosus* (Kühn) Rabenh. var. *dauci* Kühn (Alt. Chronology 1855) and is superfluous.

1863 *Sporidesmium scirpicola* Fuckel, Fungi Rhenani Exs. no. 78. [edit. in sched.]

Fuckel collected the fungus represented by this name as part of his *Nassau's Flora* and distributed portions of it as no. 78 of his *Fungi Rhenani Exsiccati*. The printed exsiccatum label with description serves as valid publication of the name. The portion of the specimen retained by Fuckel is excellent; it is at G and is selected as lectotype (EGS 37-156). Another exsiccatum unit examined as a slide preparation at IMI (ex K; EGS 17-018) is of the same fungus.

Fuckel used the name again in 1870 (*Symbolae Mycologicae*, p. 140) for the "*Fungus conidiophorus*. (?)"

Sporidesmium Scirpicola" associated with a "*Fungus asco-phorus. Sphaeria S.[cirpicola] Fr.*" He suggested this anamorph-teleomorph association as the basis for a new genus *Macrospora* Fuckel (1870, l.c., p. 139), typified by "*M.[acrospora] Scirpi*," a lapsus that he promptly corrected to *Macrospora scirpicola* (DC.) Fuckel in 1871 (op. cit., Nachtr. 1, p. 301).

The anamorph, occurring as a sparse growth on dry culms of *Scirpus lacustris* L., has pale, narrowly elongate-obclavate, transversely distoseptate and euseptate conidia that gradually taper apically. Its epithet has passed through *Clasterosporium scirpicola* (Fuckel) Sacc. (1886), *Cercospora scirpicola* (Fuckel) Zinderen Bakker (1940), and *Alternaria scirpicola* (Fuckel) Sivanesan (1984). M. B. Ellis (1976) described and illustrated the anamorph under the name *Alternaria* state of *Pleospora scirpicola*.

My notes on the cited Fuckel exsiccatum slide at IMI (EGS 17-018) recall a consensual conversation with K. Pirozynski and B. Sutton more than 30 years ago to the effect that there was no published genus name suitable for the species then, and that it and a few other similar species might be rescued from *Alternaria* under a new genus name. My opinion on the point has not changed, although I have in the past wavered toward using an expanded concept of *Drechslera* to accommodate these anamorphs, a possibility also considered but rejected by Crivelli (1983) in his work on *Pleospora* and related genera.

For these reasons and others related to the teleomorph *Macrospora scirpicola* (DC.) Fuckel (*Alt. Chronology* 1870), a new anamorph genus name was proposed, *Nimbya* E. Simmons (1989), with type species *N. scirpicola* (Fuckel) E. Simmons and a few similar taxa. Cfr. *Alt.T&V* nos. 136-140.

1864 *Sporidesmium brunneum* Bonorden, Abhandl. naturf. Gesells. Halle 8: 88. Taf. I, fig. 1.

Type material for this name has not been found. The fungus, occurring on dry stalks [plant. indet.], was described as an effuse, dark turf of conidiophores producing long, clavate, beaked phragmospores 26-46 x 7.5-10.5µm, which may occur in chains. If the substrate had been given as some species of *Brassica*, I would suggest with little hesitation an identity with *Alternaria brassicicola* (Schw.) Wilt., which the illustration strongly resembles despite the lack of mention or illustration of longitudinal septa in even one conidium. In the absence of a host clue, the fungus could be some other species of *Alternaria* or even of

another genus, such as *Torula*. The fungus is unidentifiable to species or, with any degree of certainty, to genus. It must remain so as long as authentic material is lacking.

1864 *Macrosporium clavatum* Bonorden, Abhandl. naturf. Gesells. Halle 8: 93-94. Taf. I, fig. 2.

Type material for this name has not been found. The fungus, produced on bare wood, was described as a sparse stand of dark-colored, straight, erect conidiophores, each of which produces apically a single, dark, clavate-fusiform, 9-12-septate phragmospore 57-78 x 11-13 μ m. The figure and Bonorden's description are of a *Sporidesmium* or perhaps a *Corynespora*. Bonorden suggested that the species is transitional ("eine Uebergangsform") between *Sporidesmium* and *Macrosporium*. I consider the fungus not to have alternarioid characteristics.

1864 *Macrosporium rhabdiferum* Berkeley, Gard. Chron. & Agr. Gaz. 1864 (no. 40): 938. Fig. [not numbered].

The holotype specimen at K (EGS 10-185) is a dense, tangled mat of black phragmospores covering a large circular lesion of a peach fruit, as Berkeley described and illustrated it ("In *Persicam*, Bodelwyddan, 1864"). The fungus is a species of *Stigmina* identical with *S. carpophila* (Lév.) M. B. Ellis (1959).

1865 *Helminthosporium rhabdiferum* (Berk.) Berk. & Broome, Ann. Mag. Nat. Hist., ser. 3, 15: 402.

An obligate synonym of *Macrosporium rhabdiferum* Berk. (Alt. Chronology 1864); a taxonomic synonym of *Stigmina carpophila* (Lév.) M. B. Ellis (1959).

1867 *Unio Itineraria Cryptogamica* (1863-1868)

A poorly documented series of exsiccatae was distributed under this title. The project was organized and managed by the governing board of the "Kryptogamischer Reiseverein," with L. Rabenhorst (Dresden) and W. P. Schimper (Strassburg) signing press releases. Distribution apparently was in separately numbered sets associated with the name of the collector and a specific collecting trip.

One set, attributed to the collector E. Marcucci, may have included as many as 78 fungus specimens collected in Italy and Sardinia in 1866 (fide Rabenhorst, Hedwigia 5: 144. Sept. 1866.). In several instances Rabenhorst provided names and, in some cases, technical descriptions that

were printed on the Marcucci specimen labels. Lindau and Sydow (1909, *Thesaurus Litt. Mycol. et Lichenol.*, vol. 2, p. 46) listed the Marcucci set simply as "*Unio itineraria* 1867 (Crypt. exs.)." And cfr. G. Sayre, Mem. N. Y. Bot. Gard. 19(1): 51-52. 1969.

: *Helminthosporium caespitosum* Rabenh., *Unio Itin.*
Crypt. XXXIII [edit. in sched.]

The type gathering is of fascicles of black, brittle conidiophores and phragmospores erumpent through the bark of *Quercus* twigs collected in Sardinia. It was described on the printed label. The best portion examined is at FH (EGS 08-030); it is selected as lectotype for the name. Other identifiable portions of the exsiccatum are at PC (EGS 12-039), UPS (EGS 11-069), and W (EGS 10-099). The fungus is a species of *Corynespora* Güssow with obclavate, long-erostrate conidia commonly measuring about 150 x 27 μ m.

: *Macrosporium chelidonii* Rabenh., l.c., XXXVII [edit. in sched.]

The original collection on stems of *Chelidonium glaucium* was distributed under a nomen nudum. No subsequent cataloguers of the name provided any sort of description, e.g., M. C. Cooke (1889, "Omitted Diagnoses," i.e., not found in Saccardo's Syll. Fung.); Saccardo (1892); and Ferraris (1912). Cooke (l.c.) reported that the exsiccatum portions at K "are without fruit." The portion at FH (EGS 08-031) is of an excellent species of *Stemphylium*; the same fungus appears, along with *Alternaria* conidia and *Pleospora* ascospores, on portions at PC (EGS 12-042) and UPS (EGS 11-073). The name remains without valid publication.

: *Macrosporium elegantissimum* Rabenh., l.c., XXXV [edit. in sched.]

The original collection on stems of a species of *Suaeda* Forssk. ex Scop. was described on the printed label and was distributed not only in the Marcucci exsiccata but also later by Winter (1882) as no. 2883 of *L. Rabenhorstii fungi europaei et extraeuropaei exsiccati . . . Editio nova, Series secunda*. The portions I have examined of the *Unio Itin. Crypt.* exsiccata at FH (EGS 08-029) and PC (EGS 12-047) are not very instructive, but a portion of the Winter distribution at NY (EGS 03-042), chosen here as lectotype, has at least enough conidia of the sort described by Rabenhorst to permit identifying the species as a *Stemphylium*.

: *Macrosporium oleandri* Rabenh., l.c., XXVII [edit. in sched.]

The original specimen on stems of *Nerium oleander* L. is of blackened areas or lesions bearing almost no hyphomycetous growth recognizable as such. Samples of the darkened tissue yield fragments of dematiaceous hyphae that sometimes appear to be 1-4-celled toruloid conidia up to about 15 μ m long, as Rabenhorst originally described them. The best portion seen, chosen as lectotype, is at UPS (EGS 11-083); other units of the exsiccatum, of little interpretive value, include portions at FH (EGS 08-028), PC (EGS 12-053), and W (EGS 10-102). The fungus elements have no resemblance to conidia of *Alternaria* or any closely similar genus.

: *Macrosporium spaniotrichum* Rabenh., l.c., XXIX [edit. in sched.]

The original collection on small herbaceous stems [plant. indet.] is plentiful in the form of dark, punctate to effuse eruptions of conidiophore clumps intermixed with abundant *Alternaria* conidia that are ovate to obclavate, sparingly septate when young but becoming muriform with as many as six major transverse segments and 1-6 cells in each segment, 22.4-48 X 12.8-20.8 μ m. It was described on the printed label. A good portion of the collection, chosen as lectotype, is at UPS (EGS 11-089); other identifiable portions include ones at FH (EGS 08-033), PC (EGS 12-059) and W (EGS 10-103). The fungus is *Alternaria eryngii* (Pers.) S. Hughes & E. Simmons, in S. Hughes (1958). Cfr. *Alt.T&V* no. 114.

1867 *Macrosporium peponicola* Rabenh., Sitzungs-Ber. Naturwiss. Ges. Isis Dresden 1867: 101. Tab. VI.

The lectotype (Simmons 1982, *Alt.T&V* no. 11, as "type") of this name (NY; EGS 04-058) is one portion of Rabenhorst's (1869) *Fungi europaei exsiccati*, Klotzschii herb. . . . continuatio, no. 1285. The fungus appears as a dense black mass of *Alternaria* conidiophores and conidia on a lesion of a cucurbit fruit. Transfer of the epithet has been accomplished as *Alternaria peponicola* (Rabenh.) E. Simmons (1982). Cfr. *Alt.T&V* no. 11.

1867 M. A. Curtis published five names in 1867 that have become involved in the literature on phaeodictyosporic hyphomycetes. The names appeared in his *Catalogue of the Indigenous and Naturalized Plants of the State* [North Carolina, USA], 72 pages of which were devoted

to fungi. Each of the names was attributed to Berkeley and Curtis. Specimens representing all of them are extant, but none was supported by a description; all are nomina nuda in M. A. Curtis (1867). Only one subsequently was published validly.

- : **Macrosporium antennaeforme** Berk. & Curt., in M. A. Curtis, Geol. & Nat. Hist. Surv. North Carolina, Pt. III, Botany, p. 128.

The fungus occurs on the lower surface of *Celtis* leaves that make up a pertinent specimen, no. 4873, in herb. Curtis (F; EGS 08-036). It is phaeodictytic but not an *Alternaria*. Undescribed in Curtis's 1867 list, it was published validly by Berkeley (1875) and still later was cited as the type of the genus *Sirosporium* Bubák & Serebri-anikov, in Bubák (1912), where the binomial has the form *S. antenniforme* (Berk. & Curt.) Bubák & Serebr.

The portion of the original T. M. Peters collection from Alabama in the Curtis herb. at FH, cited above, is chosen as lectotype of the validly published Berkeley name, since the original specimen exists as dispersed portions at least at FH and UPS (EGS 11-066).

- : **Macrosporium circinans** Berk. & Curt., in Curtis, l.c., p. 128.

The fungus on two portions of a pertinent specimen on cabbage leaves, no. 2461, in FH (herb. Curtis; EGS 08-038) and K (EGS 11-006), is *Alternaria brassicicola* (Schw.) Wiltshire (1947). The name is a nomen nudum in this place; it never has been published validly.

- : **Macrosporium echinellum** Berk. & Curt., in Curtis, l.c., p. 128.

The original collections, as cited, were on leaves of *Platanus* and *Ilex*. The conspicuous fungus on the *Platanus* leaves (FH; EGS 08-040) is sporodochial *Stigmina platani* (Fuckel) Sacc., bearing no resemblance to a hyphomycetous species that is present on the specimen of *Ilex* leaves. Typification is not addressed here, as the name never has been published other than as a nomen nudum.

- : **Mystrosporium rubigo** Berk. & Curt., in Curtis, l.c., p. 128.

The original collections were on *Phytolacca* stems (FH; EGS 08-048) and grasses (FH; EGS 08-049). *Alternaria*

conidia mixed with other phaeodictyic elements are present in both specimens; the two different substrates bear different species of *Alternaria*. Typification is not addressed, as the name never has been published other than as a nomen nudum.

: *Stemphylium fuligo* Berk. & Curt., in Curtis, l.c., p. 128.

The original collection on branches of *Rhus glabra* (FH; EGS 08-044) bears sparse *Alternaria* growth intermixed with other dark-spored elements. The name never has been published other than as a nomen nudum.

1867 *Helminthosporium smyrnii* Crouan, in P. L. Crouan and H. M. Crouan, *Florule du Finistère*, p. 11.

The neotype (possibly holotype; see *Alt.T&V* no. 131) of this name at CO (EGS 30-028) is a felt of dark, erect, coarse, brittle conidiophores and associated phaeodictyconidia on a dead stem of *Smyrnum olus-atrum* L. The Crouans suggested that the species be assigned to a new subgenus *Macrosporium* Fries within *Helminthosporium*, but they provided no references or typification considered necessary for establishing a subgenus legitimately; no author has followed their suggestion. P. A. Saccardo's compilation of the epithet in *Macrosporium* must read *M. smyrnii* (Crouan) Sacc. (1886).

The Crouan species name and *Stemphylium ramulosum* Sacc. (1878) are typified, respectively, by collections of the same fungus species on *Smyrnum* and *Petroselinum* ("*Apii petroselini*"), with *Helminthosporium smyrnii* Crouan having priority of publication. The fungus, because of its phaeodictyic, elliptical to ovate conidia, has journeyed nomenclaturally through *Stemphylium ramulosum* Sacc., *Macrosporium smyrnii* (Crouan) Sacc. and *M. ramulosum* (Sacc.) Sacc. (1881), and *Alternaria ramulosa* (Sacc.) Joly (1964). The taxon is an *Alternaria*, typical in its pattern of conidium production and morphologically remarkable primarily in the heavily macronematous nature of its most fully developed conidiophores, which, however, are quite typically mesonematous in young cultures.

For several years I considered basing a new genus on this species. However, after working with cultures of the fungus, I conclude that it is simply the most strongly macronematous of a series of similar species that merge back into the more comfortably acceptable bulk of *Alternaria* species with well-defined but not thick-walled conidia.

diophores. Thus, *Alternaria smyrnii* (Crouan) E. Simmons, comb. nov.; basionym: *Helminthosporium smyrnii* Crouan, in P. L. Crouan and H. M. Crouan (*Florule du Finistère*, p. 11. 1867.). This species and somewhat similar *A. cheiranthi*, *A. radicina*, *A. japonica*, *A. petroselini*, and a few other taxa are discussed in *Alt. T&V* nos. 123-131.

1868 "*Macrosporium gramineum*" in E. LeMaout and J. De-caisne, *Traité Gén. Bot.*, p. 704. Fig.[no number].

Neither a specimen pertinent to this name nor any relevant citation of a specimen has been found. The name appears only as the legend under a figure of a single clavate dictyospore and some one-celled "*spores jeunes*" that may or may not represent an alternarioid fungus. The name is a nomen nudum, without type, source, diagnosis, author or reference, or, as Saccardo (1913) commented in the only other known appearance of the name, "*absque ulla diagnosi et loco*."

1869 *Sporidesmium ulmi* Fuckel, *Fungi Rhenani Exsiccati* no. 2210.

The name first appeared in this place, but without a diagnosis or description. See *Alt. Chronology* 1870, *Sporidesmium ulmi*, below.

1869 *Sporidesmium putrefaciens* Fuckel, *Fungi Rhenani Exsiccati* no. 2211.

The name first appeared in this place, but without a diagnosis or description. See *Alt. Chronology* 1870, *Sporidesmium putrefaciens*, next entry.

1870 *Sporidesmium putrefaciens* Fuckel, *Jahrb. Nassau. Ver. Naturk.* 23-24: 350. Taf. II, fig. 32.

The portion of the original collection at G (herb. Fuckel; EGS 09-189), chosen here as lectotype, is a dense growth of *Alternaria* (intermixed with easily distinguishable *Stemphylium* conidia and conidiophores) on diseased leaves of *Beta vulgaris*. The type gathering was distributed as Fuckel's *Fungi Rhenani Exsiccati* no. 2211 (1869). Fuckel described the conidia as being oblong, 6-7-septate, and $82 \times 16\mu\text{m}$ (without beak) when mature, sometimes with a stipe [beak] as long as $56\mu\text{m}$. This description is a good match for the largest conidia found in the type specimen. The fungus is distinct from all other *Alternaria* species whose names or basionyms were published validly in or before 1870. A new combination is required: *Alternaria*

putrefaciens (Fuckel) E. Simmons; basionym *Sporidesmium putrefaciens* Fuckel (Jahrb. Nassau. Ver. Naturk. 23-24: 350. 1870). Cfr. Alt.T&V no. 144.

1870 *Sporidesmium ulmi* Fuckel, Jahrb. Nassau. Ver. Naturk. 23-24: 350.

The portion of the original collection of *S. ulmi* at G (herb. Fuckel; EGS 09-187), chosen here as lectotype, is an effuse, velvety stand of dematiaceous conidiophores and conidia on dead portions of *Ulmus* leaves. A species of *Cladosporium* is a major component of the mixed growth, a *Stemphylium* a minor component. The dominant phaeodictyosporic fungus, however, is a distinctive *Alternaria* with large, somewhat rough-walled, almost erostrate conidia like those described by Fuckel and illustrated on the lectotype folder. The original gathering was distributed in Fuckel's *Fungi Rhenani Exsiccati* no. 2210 (1869). The species cannot be identified with any other described before 1870. *Alternaria ulmi* (Fuckel) E. Simmons, comb. nov.; basionym *Sporidesmium ulmi* Fuckel (Jahrb. Nassau. Ver. Naturk. 23-24: 350. 1870.). Cfr. Alt.T&V no. 143.

1870 *Macrospora scirpicola* (DC. : Fr.) Fuckel (as "*M. Scirpi*"), Jahrb. Nassau. Ver. Naturk. 23-24: 140.

The epithet "*Scirpi*" in loc. cit. is considered to be a lapsus, as Fuckel referred directly to "*Sphaeria S. fr. Elench. II. p. 108*" [= "*S.[phaeria] scirpicola*" (Fries, 1828)], which in turn referred indirectly to "*S[phaeria] Scirpicola . . . Dec. Fr. 2. p. 309*" [= *Sphaeria scirpicola* DeCandolle, in Lamarck and DeCandolle (1805)]. Fuckel recognized the error and promptly published the correct *Macrospora scirpicola* (DC.) Fuckel (1871), q.v., below.

Macrospora Fuckel is one of the few 19th Century genus names that, by the author's original, though self-questioning ("?) intention, incorporated both a distinctive, named ascus state and a distinctive, named conidial state, *Sporidesmium scirpicola* Fuckel (= *Nimbya scirpicola* (Fuckel) Simmons, 1989). The genus is a member of the Pyrenophoraceae, sensu M. E. Barr (1987) and in accord with my understanding of the literature on the morphology of typical Pyrenophoraceae and Pleosporaceae and their anamorphs. The spelling, gender, and ascomycete relationship of *Macrospora* Fuckel are sufficient to prevent its being confused with the similar name *Macrosporium* Fr. (= *Alternaria* Nees, Hyphomycetes). (For precedent on maintaining similar but non-homonymous spellings, cfr. ICBN, Art. 53.3, Ex. 9, e.g., *Peponia* and *Peponium*; Greuter, et al. 1994.)

Macrospora Fuckel is typified by *M. scirpicola* (DC.) Fuckel. The lectotype for the name is chosen from among three portions of the original DeCandolle collection of *Sphaeria scirpicola* DC. held at G (EGS 37-154); the lectotype preparation was described in detail in Simmons (1989), where it was designated erroneously as "holotype". The type and related taxa are illustrated in the discussion of *Nimbya* anamorphs in Simmons (1989). And see Alt.T&V nos. 136-140.

1870 *Macrosporium commune* Rabenh., *Fungi europaei exsiccati*, Klotzschii herb. . . . contin., no. 1360.

This name was a *nomen nudum* when published; the name never has been validated, either on the basis of the specimen distributed in Rabenhorst's *exsiccata* or on any other specimen. The pertinent specimen actually is the remainder of a gathering of beet (*Beta*) leaves that M. C. Cooke had used for his *exsiccatum* of "*Macrosporium cheiranthi* Fr." in *Fungi Britannici Exsiccati*, Ser. I, no. 197 (issued in 1866, fide Pfister, 1985) and that Cooke later cited in typifying his *Macrosporium cheiranthi* (Lib.) Fr. var. *betae* Cooke (Alt. Chronology 1871). The fungus is a distinctive taxon of *Alternaria*. See Alt. Chronology 1870, *Sporidesmium putrefaciens* (= *Alternaria putrefaciens*), and Alt.T&V no. 144.

E. W. Mason's (1928) historical outline of the changing concepts and misinterpretations of the sort of fungus represented by the name *Macrosporium commune* is a marvelous exposition of the shabby way in which a *nomen nudum* can be used as the umbrella for descriptions of totally unrelated materials (e. g., as Penzig (1882) did for a *Stemphylium* on citrus leaves) or for combining published descriptions for putative anamorphic states of a single ascomycete species (e. g., as Saccardo (1886, Syll. Fung. 4: 524) did when he listed *M. commune* and some "varieties" (an *Alternaria* and a *Stemphylium*) as "status conidicus *Pleospora herbarum*").

It is a misfortune that the name *Macrosporium commune* Rabenh., Cooke's "Common *Macrosporium*" (1871, below), has been applied so avidly in published reports, on distributed *exsiccatum* labels, and on herbarium specimens, even well into the 1960's. Without detailing observations on this Augean accumulation, it can be summarized that some of the items represent diverse *Alternaria* species and that many of the others are *Stemphylium* species, presumably following the example of an excellent Penzig illustration (1882) of "*Macrosporium commune*" in the form of a *Stemphylium* species on citrus leaves. Buchwald dignified many of the determi-

nations by proposing a new combination "*S.[temphylium] commune* (Rabenh.) Buchw." (1939) but without specific reference or description of any sort. The original Rabenhorst name was and remains invalidly published as a nomen nudum. Miscellaneous scores of inappropriately determined specimens rest in a meaningless *M. commune* limbo in herbaria all over the world.

1871 *Macrospora scirpicola* (DC.) Fuckel, Jahrb. Nassau. Ver. Naturk. 25-26: 301.

This is Fuckel's correction of his error (Alt. Chronology 1870) in publishing "*Macrospora scirpi*" instead of the intended *Macrospora scirpicola* when he transferred *Sphaeria scirpicola* DC. to *Macrospora* Fuckel.

1871 *Macrosporium cheiranthi* (Lib.) Fr. var. *betae* Cooke, Handbook of British Fungi, p. 576.

Here, after false starts by Cooke and by Rabenhorst, a distinctive name and a description are provided for the *Alternaria* that Cooke had collected on leaves of *Beta vulgaris* and had distributed in his *Fungi Britannici exsiccati* no. 197 (1866) as *Macrosporium cheiranthi* Fries. Rabenhorst had distributed parts of the same collection in one of his exsiccati, but under a nomen nudum. See Alt. Chronology 1870, *Macrosporium commune* Rabenh., above.

Cooke's description of the variety is too imprecise for practical use, but the fungus he collected remains in recognizable condition, though sparse, on the material in his herbarium (K; EGS 10-189), which is chosen here as lectotype of the variety name. The taxon is the same as the species described by Fuckel as *Sporidesmium putrefaciens* (= *Alternaria putrefaciens* (Fuckel) Simmons) (Alt. Chronology 1870). Other units of *Fungi Brit. exs.* 197 examined bear the same fungus taxon (K, EGS 10-192; NY, EGS 05-017; W, EGS 10-100).

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ALTERNARIA THEMES AND VARIATIONS (112-144)

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ABSTRACT

Hyphomycete taxa introduced under any genus name in the literature of 1796-1871 that currently are recognized as species of *Alternaria* are characterized on the bases of type specimen, modern field material, and isolates in culture, when possible. Species that are early examples of morphologically similar species-groups are discussed along with other already known or novel group members. Included are *A. eryngii*, *A. alternata* sp.-grp., *A. tenuissima* sp.-grp., *A. cheiranthi* sp.-grp. (9 spp. with *A. atrocariis* sp. nov., *A. carotiincultae* sp. nov., *A. selini* sp. nov.), *A. brassicicola* sp.-grp. (3 spp. with *A. mimicula* sp. nov.), *A. dauci*, *A. instipitata*, *A. smyrnii*, *A. ulmi*, and *A. putrefaciens*. The genus *Nimbya*, established earlier as distinct from *Alternaria*, is discussed with *N. alternantherae* comb. nov., *N. crassoides* comb. nov., *N. pimpriana* comb. nov., and *N. celosiae* sp. nov.

Introduction

This group of taxonomic notes in the "Alt.T&V" series is adjunct to "An *Alternaria* Chronology and Catalogue Raisonné (1796-1871)," which is published concurrently (Simmons 1995). The *Chronology* accounts for each name that has been, is, or (when known to me) should be associated with the genus *Alternaria* Nees : Fr. The published source of each name is cited in the *Chronology*, along with information on its nomenclatural type, an opinion on the legitimacy of the name, its current status, and the taxonomic relationships of the fungus to which it refers.

The following notes expand upon the characters of taxa accepted in the genus (and a few that are not), with emphasis on groups of similar species, species differentiation, representative isolates, and novel taxa.

General Considerations and Conventions

Each specimen or isolate introduced into the discussion is identified by standard herbarium abbreviation or other source plus my record number, e.g., (L; EGS 11-050). A device "*Alt.T&V* no. ..." is used for referring between units in this series, whose places of publication are given later in *Literature Cited* (Simmons 1981-1995; Simmons and Roberts 1993). A similar device "*Alt. Chronology* [date]" is used for referring to dated entries in the concurrent "*Alternaria* Chronology and Catalogue Raisonné" mentioned above.

Lists of synonyms established to date are appended to names of some taxa treated below in numbered *Alt.T&V* discussions. Individual synonyms may or may not be discussed in the *Alt.T&V* notes, but each always is treated fully under its publication date in accompanying or future portions of the *Alt. Chronology*. Synonymy entry symbols: $\equiv$ obligate (same type), $=$ taxonomic (opinion), $\sim$ ICBN faulty (named in literature but nomen nudum, type or description inadequate, inseparable mixture, other as noted).

Attempts to define taxa for which living isolates are available are based on simple culture and observation techniques that can be reproduced in most laboratories. Each isolate has undergone 1-conidium or 1-chain reisolation at least once at my hands. Methods and media (PCA, Hay, V-8) are as defined in Simmons and Roberts (1993). Observations on hazards in taxonomic comparisons and suggestions for laboratory protocols for *Alternaria* studies have been published by Simmons (1992, in Chełkowski and Visconti, eds.).

Description and comparisons of living material are, to the greatest extent possible, based on cultures developed on potato-carrot agar. This relatively low-nutrient medium is used as a standard because it supports good colony development and good to excellent sporulation of almost all stable *Alternaria* isolates and because it can be duplicated readily worldwide. However, V-8 juice agar also usually supports very abundant sporulation and, importantly, may accentuate differences of conidium morphology among similar isolates. V-8 agar is used for comparisons, therefore, when there is a gain in morphological information over that provided by PCA, e.g., in the treatment below of the *Alternaria tenuissima* species-group.

Inoculated plates are held at moderate temperatures (ca. 22C) without humidity control (a gradually drying

atmosphere in temperate climates) under a cool-white fluorescent light/dark cycle of ca. 8/16 hrs.

Sporulating samples for microscopic examination usually are taken at a colony age of 1-2d in order to capture the initial juvenile conidia, which, if catenulate, may be strikingly different in shape from those produced later in the same chain; always at ca. 4-7d, when the population is likely to hold high percentages of morphologically fully developed conidia and the full range of conidium size and shape possible under given conditions; and often at ca. 10-14d, when the colony margin of most isolates has reached culture plate limit, conidium production has practically ceased, and the sporulation pattern has reached its limits of branching (if any).

Relative size terms frequently are used to avoid stating unnecessarily strict measurements in general discussion. For this purpose "small" indicates a length range up to ca. 30-40 μ m; "medium" or "moderate" ca. 50-100 μ m; "large" ca. 100+ μ m, but certainly with overlapping ranges, to be interpreted within the context of the species-group under discussion.

The terms "cicatrix" and "scar," as used by M. B. Ellis (1971, 1976) in his descriptions of the contact areas between *Alternaria* conidia and conidiophores, have not been used here. The terms suggest some sort of structure that becomes visible following separation of conidium and conidiophore. The *Alternaria* conidial connective is, in fact, extremely narrow, thread-like, and rarely seen in ordinary inspection. When it breaks, the minute severed ends (the only structures that might be termed "scars") retract within the terminal walls and are hidden by a ring area of pigment or by the wall curvature. It is this pigmented area, often present and conspicuous in *Alternaria* whether the conidium remains attached or not, that has been called scar or cicatrix. The terms seem to me inappropriate. Lacking a better term, I usually have used "conidiogenous site" plus any needed qualifying comment.

Study mounts routinely are made in U. S. pharmaceutical grade lactic acid (86%), which presumably becomes ca. 100% after routine gentle heating of slide preparations. Lactic acid with Cotton Blue dye (0.05-1.0g/100ml ad lib.) and glycerine is used rarely. NB: fresh conidia of a very high proportion of well-pigmented isolates of *Alternaria*, when examined microscopically in lactic acid, have colors suggesting a dilute grey-green overcast that modifies

underlying yellow-gold-brown tones; the grey-green cast usually disappears within a few days, revealing the varieties of wall color that then seem to remain unchanged for long periods of time. Color comparisons of fresh material with older, particularly herbarium material need to take this phenomenon into account. It is equally important to discount the kinds of excessive pigmentation, wall thickening, and spore ornamentation induced by exposure of developing cultures to near-UV radiation, a technique once widely used to induce sporulation but not to be recommended in comparison work, particularly between field growth and laboratory culture.

XIII. ALTERNARIOID PHAEODICTYOCHLAMYDOSPORES

Aerial chains of thick-walled, transversely to muriformly septate hyphal enlargements that develop apically often mimic short chains of *Alternaria* conidia. These thick-walled enlargements arise from morphologically unspecialized hyphal sites; they secede through irregular fracture of the sturdy isthmi that link them.

Populations of some of these entities are distinctive enough to have been described as species, sometimes in *Peyronellaea* Goidanich (in Togliani 1952) or in *Peyronelia* Cif. & Gonz. Frag. (1927), but also in *Alternaria* Nees (1816) and *Macrosporium* Fr. (1832). The type of *Peyronellaea*, *P. glomerata* (Corda) Goidanich (in Togliani 1952), incorporates both a characteristic pseudoalternarioid state and a phomoid pycnidial state; Sutton (1980) includes coelomycetes of this sort in *Phoma* Sacc. (1880a). Species lacking a pycnidial state are included in *Peyronelia*.

112. *Peyronelia rudis* (Ehrenb. : Fr.) S. Hughes (1958),
Canad. J. Bot. 36: 795. Fig. 91

= *Alternaria rudis* Ehrenberg, Sylvae Mycol. Berol.,
p. 10 & 22. 1818.

= *Torula rudis* (Ehrenb.) Fr., Systema Mycol. 3: 500.
1832.

Alternaria rudis was the second species described in *Alternaria*, after *A. tenuis* Nees (1816). Although it is not an *Alternaria*, it is considered here in order to introduce a reference point for generically similar material originally described in *Alternaria* or *Macrosporium*.

Ehrenberg's description (1818) is from a collection

on a pine trunk blackened by the fungus. The label on the specimen selected as lectotype (B; EGS 09-093; *Alt. Chronology* 1818) gives Berlin and April as additional data. No author has added to the original description, which simply states that *A. rudis* comprises a complex growth of small stick-like fibers ("rudes") that are short, rigid, and black and that have articulated nodular elements associated with them. I am not aware of any more useful published description or illustration, which has meant that what possibly is a common wood-inhabiting fungus has remained unidentifiable in general practice for 150 years or more. *Peyronelia rudis* is described and illustrated here from the lectotype and from what appears to be another portion of the original Ehrenberg collection (UPS; EGS 09-032).

Mycelium on the substrate is medium orange-brown, septate, 3-4 μ m diam., often distinctly and coarsely rough; hyphae often run parallel to the long axis of cells in substrate tissue but usually branch on the exterior and appear as a non-patterned network. Sporulation units are produced as enlarging tips of short branches, at first concolorous with surface mycelium but soon dark orange-brown and finally black-brown and opaque. In type material an occasional enlarging branch can be seen attached to the hypha from which it developed; in most instances, however, the enlarged branch elements have broken loose from the mycelium or are so densely crowded on the substrate and so nearly opaque that points of attachment cannot be traced.

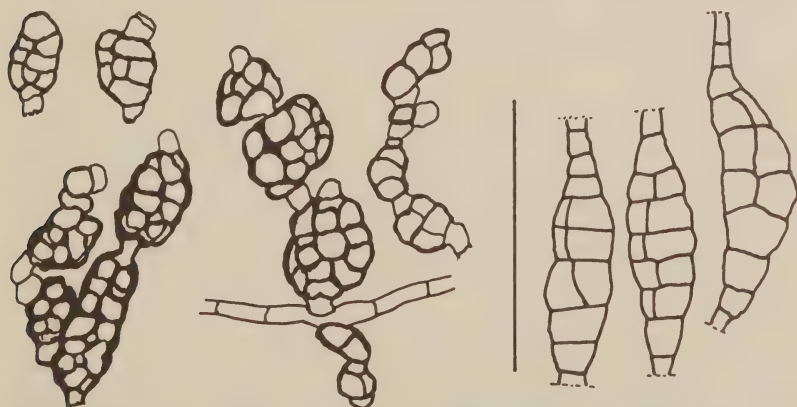


Fig. 91. Phaeodictyic hyphal elements from lectotype of *Peyronelia rudis*, left of bar (B; EGS 09-093); and from lectotype of *Macrosporium pinquedinis*, right of bar (K; EGS 11-018). Bar = 50 μ m.

Main septa in young branches usually are transverse, later ones longitudinal or oblique. Spore walls are thick and externally coarsely rough. Spores are released by fracture of the basal cell of the hyphal branches that produced them; the basal cell is somewhat pale in contrast to the dark color of the enlarged portion of the spore. The enlarged phaeodictytic elements become subsphaeroidal to ellipsoidal and commonly occur in chains of 2-3 units with narrow, pale connective cells. Sizes of the multicellular elements reach a range of 15-30 x 10-18 μ m.

113. *Macrosporium pinguedinis* Berkeley (1845), Hooker's London Journ. Botany 4: 309. Fig. 91

A dense, matted mixture of hyphomycetous fungi nearly covers the fat-soaked leaves that are the type substrate (K; EGS 11-018). Berkeley (1845) illustrated elements of the named fungus in such a way as to suggest *Alternaria*-like, lanceolate or clavate phaeodictyospores. Some of the fungus structures present are as drawn by Berkeley, i.e., elongate phaeodictytic elements with a swollen, septate central region and narrow, fractured ends. Other fungus structures present in the mixture are of a small-spored *Alternaria* unlike the type illustrations, a *Curvularia*, and a miscellany of penicillioid conidia.

The distinctive septate units of *M. pinguedinis* are 50-60 x 10-14 μ m with 6-8 transverse septa and one longiseptum in some of the widest central segments, pale yellow-tan, and have slightly rough walls constricted at septa. No units observed were attached to each other or to generative hyphae.

Macrosporium pinguedinis might justifiably be transferred to *Peyronelia*, along with *P. rudis*. However, I will not do so for such a poorly defined entity. The taxon has been included here only to further my intention to comment on each *Macrosporium* species name in the literature and to guard against unwarranted transfer of such alien taxa into *Alternaria*.

XIV. ALTERNARIA ERYNGII

Fifteen species names were published in the genus *Conoplea* Pers. (1797) in the period 1797-1822, the latter date being that of Persoon's *Mycologia europaea*. Nine of these had been proposed by Persoon. According to Hughes (1960), the nine now are assignable to species of *Conoplea*,

Periconia, *Chaetomium*, *Phaeodimeriella*, *Gonytrichum*, *Sarcopodium*, and *Alternaria*.

The one Persoon species of interest here, *Conoplea* (eventually *Alternaria*) *eryngii*, was shifted to other genera by Chevallier (1826) and Fries (1832). The same fungus was described again in at least two other genera by Desmazières (1846) and Rabenhorst (1867). (See synonymy for *Alternaria eryngii* below.)

These several different interpretations need not be surprising, for Persoon himself (1822) set a precedent by suggesting in his type discussion that a new genus *Elosia* possibly could be based on *C. eryngii*; a Persoon manuscript name "*Elosia Eryngii*" actually appears on the label of the *Conoplea eryngii* holotype specimen. Persoon did not, however, proceed to use the genus name *Elosia*. When attributed to Persoon, *Elosia* is an illegitimate provisional name that has not been validated since it was suggested in 1822.

114. *Alternaria eryngii* (Pers. : Fr.) Hughes & Simmons in Hughes (1958), *Canad. J. Bot.* 36: 735. Fig. 92

- = *Conoplea eryngii* Pers., *Mycol Europ.* 1: 11. 1822.
- = *Exosporium eryngianum* Chevallier, *Fl. env. Paris*, p. 39. 1826.
- = *Exosporium eryngii* (Pers.) Duby, *Bot. gall.* II, p. 882. 1830.
- = *Helminthosporium eryngii* (Pers.) Fr., *Syst. Mycol.* 3:361. 1832.
- = *Myrothecium pyriforme* Desmaz., *Pl. Crypt. France*, ed. 1, fasc. 30, no. 1494. 1846.
- = *Macrosporium spaniotrichum* Rabenh., *Unio itin. crypt.* XXIX. 1867.
- = *Myrothecium pyriforme* Desmaz. var. *multiseptatum* H. & P. Sydow, *Hedwigia* 39: 132. 1900.

Alternaria (*Conoplea*) *eryngii* appeared to Persoon at first glance ("*primo intuitu*") to be a crust-like growth on dry stalks of *Eryngium campestre*. With the aid of a lens he was able to distinguish rounded clumps of very short, rigid, black hyphae intermixed with turbinate spores; the clumps were interspersed with subglobose, substipitate cellular masses. The holotype (L, no. 910,263-1237; EGS 11-045) fits the description well; but the description is inadequate for recognition or comparison work, particularly as no subsequent author has added illustrations or details of conidium morphology based on Persoon's type or on

authentic material of synonymic taxa. (And see reference to an Ondřej illustration in discussion below of modern collections.)

Mycelium of the holotype forms an irregular network over and within the tissues of the host plant. Very numerous small sclerotial units are scattered throughout the network, both on the substrate surface and commonly within single cells of the host tissue, where they assume the general shape and size of the host cells. The sclerotia consist of thick-walled, dark yellow-brown to brown, essentially isodiametric cells; a high percentage of the sclerotia are in a size range of $35\text{-}50 \times 45\text{-}75\mu\text{m}$. Conidiophores are produced singly, but as many as 2-5 may arise separately from an individual sclerotium; $8\text{-}12 \times 25\text{-}65\mu\text{m}$, 2-6 septate, medium yellow-brown, with a single well-defined apical conidiogenous site and pigmented ring. Conidia are not seen attached to conidiophores or to each other in chains; conidia with 2 or more conidiogenous beak sites are rare. Conidia are short oval, short to long conical or short to long ovoid; pale yellow-brown to medium yellow-brown, becoming dark brown in the spore-body with a paler beak; transverse septa (0-)3-7(-9), longitudinal 1-2 in each of 1-5 of the transverse compartments; commonly $25\text{-}57 \times 12\text{-}19\mu\text{m}$ (max. $75 \times 21\mu\text{m}$, av. about $42 \times 15.5\mu\text{m}$); beakless or with 1-2 sturdy beak cells that taper gradually to a blunt apex; beak portion at most $25\mu\text{m}$ in length, and in general not well delimited from body of conidium; outer walls smooth, rarely inconspicuously rough.

The obvious abundance of small conidiophorous sclerotia in this field specimen is in no way unique to *A. eryngii*. Old herbaceous stems frequently have areas dotted with such resistant structures, and it is fruitless to try to predict for individual specimens what species of *Alternaria*, *Cladosporium*, or other genus may emerge from them when held in a damp chamber.

The name devised by Persoon and its sanctioned form in Fries, *Helminthosporium eryngii*, did not come into common use, perhaps because Desmazières described the same fungus in more usable terms in 1846 and made collections of his *Mystrosporium pyriforme* more generally available as no. 1494 of his *Plantes crypt. France*, ed. 1. The identity and uniqueness of the taxon within *Alternaria* was recognized by Hughes and Simmons (Hughes, 1958) in terms of the characters summarized above.

Classical specimens of *Alternaria eryngii*, including

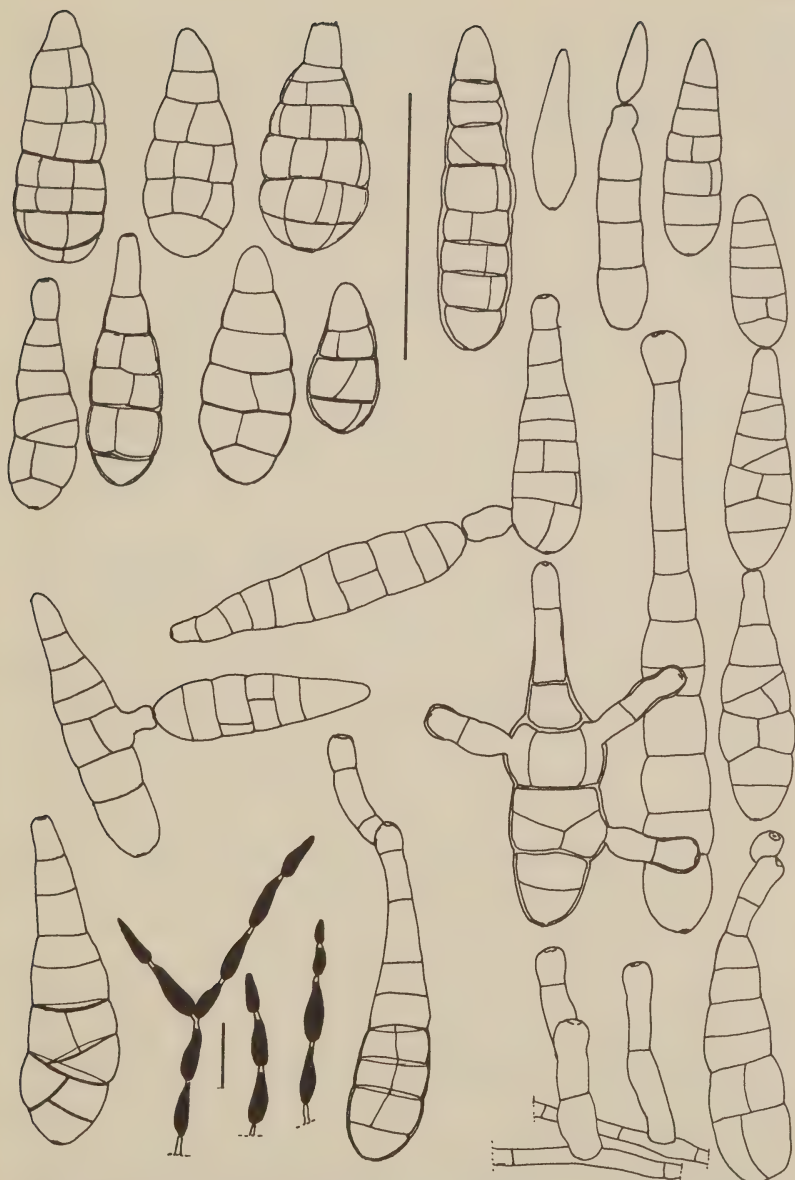


Fig. 92. *Alternaria eryngii*: 7 conidia at upper left from holotype (L; EGS 11-045); other conidia and conidiophores from representative isolate EGS 41-005 (10d PCA). Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

type material of Persoon, Desmazières, Rabenhorst, and Sydow (see synonymy above), are practically interchangeable in morphology and are readily identifiable with each other as a taxon that commonly sporulates in nature as solitary or short-chain ovoid conidia with a bluntly rounded apex.

Two modern viable collections, almost certainly held under artificially moist conditions before they were dried for shipment to me, reveal a more complex and, at first, puzzling picture of sporulation. Both specimens originated in The Netherlands. One on diseased stems of *Eryngium planum* became available in October 1985 through the generosity of S. M. Francis (IMI 297763; EGS 38-138) and of the originating institution, the Plantenziektenkundige Dienst Wageningen. Another was on leaf spots of *Eryngium* sp. intercepted in 1992 by New Zealand inspectors of fresh flowers air-jetted from The Netherlands (Lynfield PPC, Auckland, AK 4116; EGS 41-003); an isolate EGS 41-005 from this latter specimen serves as the basis of culture observations below.

The most striking conidia in these modern specimens have elongate, tapered but not filamentous beaks almost concolorous with the spore bodies. Conidia of this sort had not been seen in classical specimens of *A. eryngii*. An initial inclination was to distinguish the long-beaked taxon as a second species on members of this umbelliferous genus, even though Ondřej (1974) had not done so when he illustrated conidia 50-150(-180) x 10-16(-22) μm from a specimen identified as *A. eryngii* on *Eryngium campestre* L. The initial reaction cooled when it was found that moderate numbers of typical (i.e., classical specimen) non-beaked *A. eryngii* conidia were present in every slide preparation of modern field material and that duplicates of the original long-beaked conidia never were found in a score or more of isolates grown under routine conditions of culture.

Returning to slides prepared from the original viable specimens, it proved possible to select a series of conidia that illustrate the development of typical blunt-apex conidia into the considerably larger long-beak units. This species provides an excellent example of the potential for modifications in morphology of spores produced under different conditions as well as of the ICBN reminder (Greuter et al. 1994, ICBN Art. 7.2) that the "nomenclatural type [specimen] is not necessarily the most . . . representative element of a taxon."

Alternaria eryngii sporulates prolifically in axenic

culture, where it presents additional characters that certainly are not predictable from classical material and scarcely so from abundant spore populations of the modern collections seen. Notable among these characters are rapid production of abundant, moderately long chains of conidia and, in the conidia themselves, transverse septa of such dark color that they almost appear to be (but are not) embellisioid.

Conidia develop in PCA cultures in unbranched or branched chains, with a major axis of up to 8-10 units and occasionally 1-2 lateral branches of 1-4 units. The branching may originate either in successive conidiogenous sites of geniculate apical secondary conidiophores or from short conidiophores produced laterally from conidium body cells. Conidia are ellipsoid to ovoid, beakless when terminal or, when intercalary in the chain, with a short, poorly differentiated terminal area or cell that functions as a conidiophore; secondary conidiophores sometimes are 2-4 cells long. Conidia are essentially smooth or rarely inconspicuously minutely rough, dilute grey-tan with slightly darker septa; they commonly reach full size at ca. 45-60 x 13-18 μ m and have 5-8 transverse septa and 1(-2) longitudinal or oblique septa in a few of the central compartments. Most transverse septa appear somewhat thickened and darker than the conidium wall, thus appearing almost embellisioid. However, changing focus serially through the septa shows that their denser color and apparent thickness are due to the additive effect of pigmented walls viewed at slightly tilted angles.

XV. THE *ALTERNARIA ALTERNATA* SPECIES-GROUP

There is no modern consensus, general or specialist, on the characters and circumscription of *Alternaria alternata* (Fr. : Fr.) Keissler (1912) (originally *A. tenuis* Nees 1816). There never has been one at any time since Nees introduced the genus (1816). I think that there never will be one on the basis of identification of field specimens, for the stable differences among isolates derived from multiple, morphologically similar natural populations of *A. alternata sensu auct.* spores are numerous and much too diverse to be acceptable in a one-taxon concept of the name. It remains to be tested whether or not a supportable circumscription of the component species of the group can be developed on the basis of isolates compared in pure culture, as I attempted to do recently in an intensive examination of the morphology of several hundred small-spored,

catenate isolates (Simmons and Roberts 1993.)

The neotype specimen of *A. alternata* has been designated, discussed, described, and illustrated (Simmons 1967). (See *A. alternata* below for summary of 1967 observations.) Although the yield of morphological information from the type is not abundant, it still is defensible to state that similar material frequently is found in many field collections, both classical and modern.

The problem that arises, in this age of taxonomically profitable pure culture studies, is that even when field specimens of *Alternaria* have some conidial characters in common it seldom is possible to predict exactly what pattern of sporulation and conidium morphology will develop while a specimen is held in a damp chamber overnight. The predictability level falls even lower when 1-conidium and 1-chain isolates from several specimens are studied further in parallel cultures.

Species of *Alternaria* that readily produce branching chains of small to medium-size, short-beaked conidia usually are equated with *A. alternata*. For purposes of discussion, the *A. alternata* group of species is considered to be represented by isolates that produce conidial chains of moderate length (10-20 units, and more as branching proceeds) on relatively short conidiophores; conidia that may reach full size in a range of about 40-70 x 15-20 μ m, though some species of the group never have such maximum conidium sizes in culture (e.g., *A. alternata* conidia typically do not exceed 50 μ m in culture); and conidial bodies that for the most part lack a well-defined, apically tapered portion (although a short-tapered beak may occur in nature), the conidia usually proliferating by means of an apical secondary conidiophore (pseudorostrum) that seldom is more complex than 1-2 short cells.

A few well-known phytopathogenic species of the small-spored, short-beaked, catenate group are readily differentiated on a basis of conidium and colony morphology and host relationship (e.g., *A. longipes*, *A. brassicicola*). However, preponderant numbers of leafspot dwellers, stem invaders, seed-coat colonizers, organic debris overwinterers, endophytes, and air entrapments prove, when cultured, to be species that readily produce chains of conidia that are small to moderate in size. Much more often than not these emerge from the determination process labeled, almost in despair, as *A. alternata*, even when there are morphological differences, as in *A. gaisen* Nagano, obvious to anyone

who looks beyond overlapping size ranges of spores in slide preparations.

The extensive literature associated with the name *A. alternata* abounds in comments on remarkable differences in conidium size, shape, rostration, color, and ornamentation; on chain length and pattern of branching; and on colony characters of stable cultures. Unfortunately, a balanced synthesis of such literature is not possible when the cultural stability and health of isolates are not known; when temperature and light conditions of culture are not comparable; and when culture substrates range from minimally nutrient (water agar with wheat straws; hay decoction agar), through low nutrient (potato/carrot agar) and moderately nutrient (V-8 juice agar), to highly nutrient (malt extract or maltose and potato/dextrose agars overloaded with available carbohydrates). Associated with the vagaries of observations on non-comparable cultures is the practice of attempting identifications primarily on the basis of slide preparations of conidium samples from culture. Even when the source culture is young and sporulating well, the derivative slides contain populations of detached conidia and conidiophores that yield few clues to the inherent developmental patterns of individual conidia and of the chains in which they were produced.

Many of the classical specimens and taxa that have influenced concepts of the *A. alternata* complex have been illustrated and discussed most helpfully (though sometimes with erroneous nomenclatural conclusions) by Mason (1928), Wiltshire (1933), and Neergaard (1945). Neergaard, whose studies of large numbers of isolates (mostly from Denmark) remained until recent years our best introduction to the group, devised a narrow concept for one commonly-encountered small-spored segregate and called it "*Alternaria tenuis* [*alternata*] auct. sensu str."; his many other similar but distinguishable isolates were disposed as "*Alternaria tenuis* [*alternata*] auct. sensu lato."

For the past several years, even after growing and comparing hundreds of isolates from a very broad geographic and substrate range, I have, for the most part, declined to give opinions in the group more precisely than "*A. alternata* sp.-grp." or, when feeling particularly brave, "*Alternaria* sp. near *A. alternata* but not identical" or an equally equivocal "a distinct *Alternaria* sp. known to me from other sources but not typical *A. alternata*."

The professional as well as the tyro, then, has

little in the way of guidance and ends with either another *A. alternata* (mis)determination or another "new species." And this, of course, explains the difficult position of reference culture collections, where nearly all holdings of "*A. alternata*" should be labeled "*auct. sensu lato*," for if one morphological entity of the holdings (any one) is chosen as typical *A. alternata*, all of the others will be demonstrably something else.

Finally, it is my purpose to present what I consider to be typical *A. alternata* and to begin to segregate and find names for other species of this dismayingly heterogeneous species-group. Over the years I have given the opinion that there are a dozen to a score of distinguishable species in the *A. alternata* group. I remain firmly and, I believe, justifiably convinced in this opinion.

Several hundreds of the *Alternaria* isolates that I have examined over the years fit a generalized definition of the *A. alternata* group, as outlined above. Large numbers of these are practically worthless for purposes of strict comparisons and identification, having originally been or, over the years, become culturally unstable (poorly- or non-sporulating, demonstrably internally parasitized, or simply wet/collapsing/slimy). Attempts to stabilize or to induce abundant sporulation in most of these almost always have proved futile; once an *Alternaria* isolate has "gone bad" it usually defies rehabilitation.

Still other isolates of the *A. alternata* group, numbered in the scores rather than in the hundreds, have remained stable in growth and sporulation over the years. The great diversity of their habitat and substrate sources worldwide supports the expectation that some kind of taxonomic sense can be made of the group when enough segregates are defined for recognizable patterns of conidium and chain development under defined, controlled culture conditions.

Early clues to the existence of multiple distinguishable taxa become apparent when several isolated, morphologically similar single conidia of "*A. alternata* group" specimens give rise in culture to colonies that are dissimilar in some macroscopic factor of growth rate, zonation, mycelium density, apparent color, or timing and density of sporulation. If in addition, low magnification (50x) examination of sporulation patterns reveals different systems of branching, or none, then some macro- and mesoscopic diagnostic characters have become available. And if definable, disjunct associations of colony and sporulation pattern can

be shown to be linked consistently with some distinctive conidium morphologies, we approach a classification system for taxa of this heterospecific *A. alternata* group.

This viewpoint and approach are not particularly novel except that they have not been applied to the problems of characterizing *Alternaria* species. They constitute essentially the same pattern of classification steps used in differentiating closely similar species of *Penicillium*, *Aspergillus*, *Fusarium*, etc., except that in *Penicillium* and *Aspergillus*, for example, the morphology of the complex conidiogenic apparatus gives more clues to diversity than do the simple conidia, whereas just the converse is true in the *A. alternata* group with its relatively simple conidiophores and heteromorphic conidia.

A review of many of the most stable isolates of the group has made it possible to select several mutually exclusive patterns of conidium development and chain proliferation. One of these patterns has been chosen to represent what I consider to be typical *A. alternata*; this pattern of specific characters will be the model against which my comparisons of other segregates of the group will be made in the future. The pattern has been discussed in a preliminary way and illustrated in Simmons (1992) and in Simmons and Roberts (1993).

115. *Alternaria alternata* (Fr. : Fr.) Keissler (1912),
Beih. Bot. Centralbl. 29: 434. Fig. 93

= *Torula alternata* Fr., Syst. Mycol. 3: 500. 1832.

= *Alternaria tenuis* Nees, Das System der Pilze und Schwämme, p. 72. 1816.

Conidia of the type material of *A. alternata* have been illustrated in *Alt.T&V* no. 6 (Simmons, 1981; Fig. 6); they also were illustrated and described in detail in an earlier typification study (Simmons, 1967).

The general appearance of the type is that of relatively small dictyoconidia that may reach dimensions of about 50 x 18µm but that average about 31 x 13µm in the very meager sample available. Many of the conidia have a short conical, narrowly tapered beak, some others are beakless, and still others have a short apical secondary conidiophore. Some of the conidia are punctate roughened, others apparently smooth. Conidia are not strongly constricted at any transverse septum, and no septum is remarkably thicker or darker than any other.

Materials incorporating conidia with very much the same appearance have been collected in nature innumerable times over the past 150+ yrs. Identifying all of them as *A. (tenuis) alternata* has been the common practice which, however, has fostered an unstrenuous, undiscriminating, and therefore purposeless approach to a very complex group of species. Further use of such uncritical identifications frequently has been of little practical significance. But when the need arises to know whether or not a group of these similar collections actually represents a single biological species (with similar substrate preference or infectivity, seasonal occurrence, distribution, allergenicity, biochemical activity, etc.), then isolation, cultivation, and examination of artificially produced populations become necessary.

In 1985-86 I restudied scores of isolates that fall within the concept of the "*A. alternata* group" outlined above. Only well-stabilized isolates were considered for promulgation as "representative" strains: no sectoring in culture, no patches of sterile hyphae, no deliquescent mycelium, no internal hyphal parasites. Perhaps half-a-dozen definable segregates became apparent during this initial review. Representative strains of *A. alternata* are discussed here; others will be treated in more detail when appropriate names for them are reached in the parallel *Alternaria* Chronology. The representative strains of *A. alternata* discussed here in my strictest interpretation of the taxon are EGS 34-016, 34-039, 35-056 and 35-193. All are on deposit with major international culture collections (e.g., ATCC, CBS, DAOM, IFO, IMI). It has been my practice for several years to recommend EGS 34-016 as a standard strain for comparisons in allergy, phytopathology, metabolite, molecular, and other areas of mycological research, in hope of developing a strong data base on the taxon.

The isolates chosen to represent *A. alternata* do no violence to the concepts held by Neergaard (1945, Fig. 8 & 9) for his "*Alternaria tenuis* auct. sensu str.," by M. B. Ellis (1971, Fig. 330) for "*Alternaria alternata*," and by Groves and Skolko (1944, Fig. 12) for their "*Alternaria tenuis* auct.," although differences in culture conditions (particularly their use of malt agars) make close comparisons impossible. Conidia and sporulation patterns from representative isolates are illustrated in Fig. 93.

Radial growth rate of typical *A. alternata* colonies is about 5mm/d under standard conditions. Concentric rings of alternating dense and moderate sporulation are obvious

on all media (particularly so on PCA and V-8); these indicate increments of radial growth during successive exposures to daily light/dark cycles. To the unaided eye the less dense portions of the colonies (all media) appear minutely but distinctly granular in transmitted light; each minute spot is seen, at low magnification (50X), to be a sporulation clump; each uncrowded sporulation unit near the colony circumference can be seen to comprise a single, usually erect conidiophore and a cluster of conidia in branching chains. The colonies have no height above the agar surface other than that of the conidiophores and their spores, i. e., there is no non-sporulating surface or aerial mass of mycelium, no sterile tufts of hyphae, and no non-sporulating sectors by the end of 10-12 days under specified conditions. Colony color and texture are simply those of the massed sporulation apparatus, almost sooty black and minutely tufted to densely turfy. No pigment is released into the media.

Conidiophores typically arise singly from vegetative hyphae that are within or flat on the surface of the agar substrate. On Hay the conidiophore tends to branch or become successively geniculate near the substrate surface and to initiate 2-8 chains that develop into a basally tight, radially loose cluster of about 50-75 conidia. On PCA, branching of the conidiophore is not a striking character, although as many as 2-3 such branches (and therefore 1-3 conidial chains) may occur. Instead, the more obvious branching is initiated within the chains when a few secondary conidiophores (intercalary conidial pseudo-rostra) develop 2-3 conidiogenous loci. Uncrowded sporulation units on PCA reach a maximum of about 75-125 conidia; the clusters appear looser and the chains longer than those on Hay. In older portions of any colony, crowding of erect conidiophores and their complements of aerial sporulation present a picture of a solid turf of overlapping, intertwined conidial chains.

Conidia appear olivaceous, a dull grey-green-brown, when first mounted in lactic acid for microexamination; they lose the green tone after a few days and exhibit pale to moderate shades of a yellowish to golden brown. Although the branched sporulation complex supported by a single conidiophore often consists of more than 100 conidia, single chains traced from initial to youngest conidium (ignoring branches) have about 15-20 conidia on PCA and 8-10 on Hay; the density of sporulation on V-8 permits only an estimate that chain lengths are about the same as those produced on the other media.

A few conidiophores and their first 1-2 conidia are produced within 24-48 hours after inoculation of media. Initial conidia are narrowly ellipsoid when transverse septa begin to form, progressively about $16 \times 6\mu\text{m}$ (1 septum) to about $25-40 \times 8-10\mu\text{m}$ (3-5 septa), at which stage the distal cell produces a 1-celled secondary conidiophore approx. $4 \times 4\mu\text{m}$. Initial juvenile conidia are subhyaline and so densely, minutely granulate-roughened that septa can be demonstrated only through careful focussing. The first conidium produced and at least the second one of the chain remain long elliptical as they mature with 4-6 transverse and usually no (rarely 1-2) longitudinal septa. Young conidia produced later in the chain are in general relatively wider and shorter ovoid, ellipsoid or subsphaeroid, maturing for the most part with 3-5 transverse septa (to 6-7 on V-8) and 1 longitudinal septum (occasionally 2 in a central transverse segment on Hay). Secondary conidiophores on conidia within the chain may be short, 1-celled (as in primary conidia), occasionally 2-3 times as long, or sometimes reduced simply to a conidiogenous pore in an otherwise undifferentiated apical cell. Constriction of the conidium body at the transepta is minor, rarely conspicuous. Infrequently one median transeptum of a mature conidium is slightly thicker and darker than the others; in general, however, absence of a darker median septum is characteristic of the group. The original minute, dense ornamentation of juvenile spores usually becomes conspicuously granular as conidium walls mature and darken; the walls of some old spores often become variously verrucose. At the same time the surface of the distal conidial cell (the secondary conidiophore) remains quite smooth.

Size ranges of mature conidia (ones that have produced a secondary conidium) in chain complexes that have stopped producing new spores are about $10-30 \times 5-12\mu\text{m}$ (PCA), $10-24 \times 6-13\mu\text{m}$ (Hay), and $13-43 \times 8-14\mu\text{m}$ (V-8), excluding dimensions of secondary conidiophores. Size range data of this sort is of extremely limited utility, if any, in differentiating otherwise morphologically disparate taxa within the *A. alternata* group. For example, maximum length usually does not have positive correlation with maximum width; and the total range itself may be duplicated in a different taxon with a different pattern of conidium enlargement and, therefore, of conidium and chain morphology. Focus on patterns of conidium development within single spore heads and on pattern of chain proliferation is more useful in defining segregates than is attention to overall size ranges.

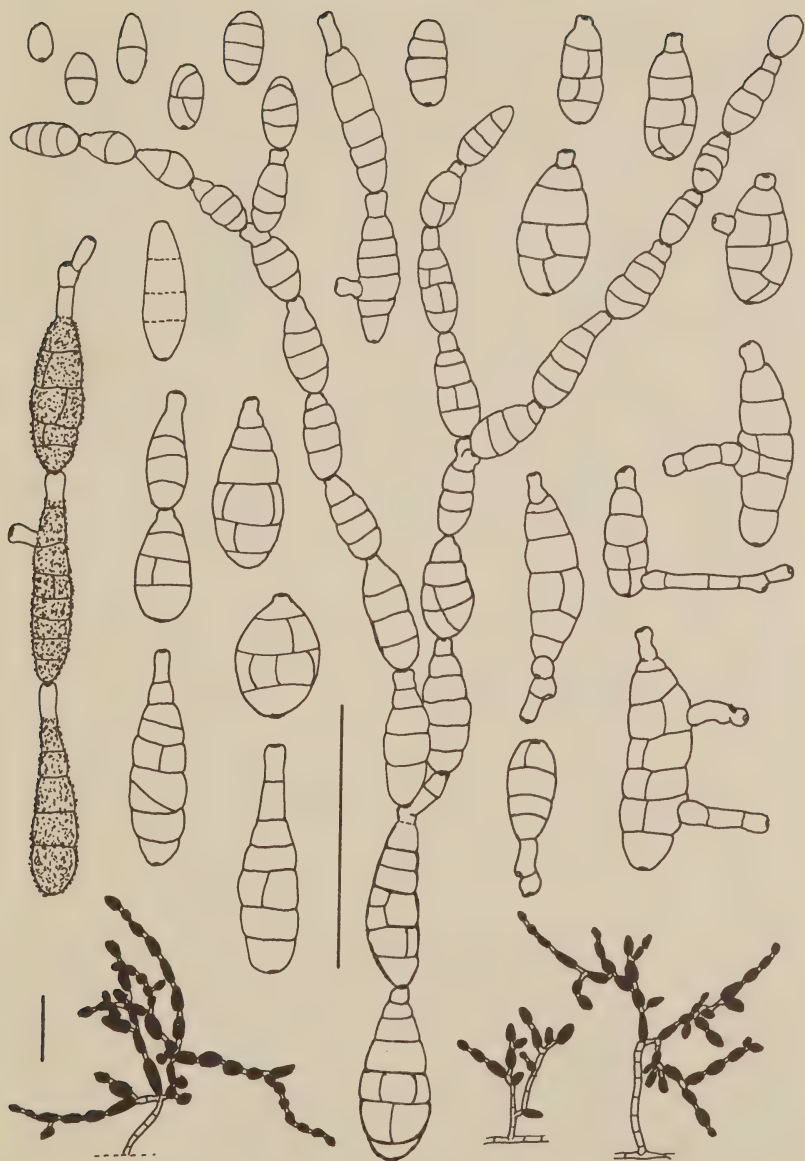


Fig. 93. *Alternaria alternata*: conidia and chains from EGS 34-016 and 35-056 (7d PCA); 3 conidia in chain at left are initial juveniles; all conidia are ornamented. Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

A few diagnostic characters have proved helpful in screening typical *A. alternata* from somewhat similar taxa. Positive identification of *A. alternata* rests on the entire description of the species, but the shape of initial conidia and the nature of the spore wall ornamentation are constant enough among representatives chosen for the species that I am using them, and promoting them, as benchmarks of the taxon as long as they prove uniquely associated with the sporulation characters that additionally define the species. Specifically, the first conidium produced on a conidiophore of *A. alternata* usually is narrowly elliptical, straight or slightly inequilateral, densely and obscuringly minutely ornamented, and up to about $40 \times 10 \mu\text{m}$ with 3-5 transepta when it initiates an apical secondary conidiophore. As for the surface ornamentation of conidia, it often becomes progressively coarser and more striking as conidia age. It is not invariably present; but when it is, it can effectively mask young septa. Thus, at low power magnification (150X) many conidia of all sizes, including the largest, appear in surface view to be hazy-brown aseptate units; refocusing reveals septation that had been obscured by overlying ornamentation.

XVI. THE *ALTERNARIA TENUISSIMA* SPECIES-GROUP

116. *Alternaria tenuissima* (Nees & T. Nees : Fr.) Wiltshire (1933), Trans. Brit. Mycol. Soc. 18: 157.

Fig. 94

- = *Helminthosporium tenuissimum* Kunze ex Nees & T. Nees, Nova Acta. Verhandl. K. Leopold.-Carol. Akad. Naturfors. 9: 242. 1818.
 = *Macrosporium tenuissimum* (Nees & T. Nees) Fr., Syst. Mycol. 3: 374. 1832.

Typical *A. tenuissima*, as neotypified by Desmazières' *Plantes Crypt. France* no. 212 (1827) (Alt. Chronology 1818, 1832), has long-obclavate conidia of medium size that taper either gradually into an awl-shaped beak or abruptly into a cylindrical secondary conidiophore. Reconstructed from drawings of conidia by Wiltshire (1933) and my own observations, sporulation in nature is in straight chains of a few conidia. An apical secondary conidiophore occasionally shows two sporulation sites, thus indicating the uncommon existence of branching in the sporulation pattern.

Conidia of the neotype reach a maximum size range of ca. $60\text{-}75\text{-}90 \times 12\text{-}15\text{-}20 \mu\text{m}$. They have as many as 7-10



Fig. 94. *Alternaria tenuissima*: conidia ex neotype specimen (K; EGS 38-133). Bar = 50 μ m.

complete or partial transverse septa and 1-2(-3) longisepta through each of most of the transverse compartments; 1-3 of the complete transepta (the earliest formed) are darker and more constrictive than the others. Conidia are pale brown and have apparently smooth to obviously but sparingly punctate-roughened outer walls.

Primary conidiophores are ca. 50-60 x 4-5 μ m and geniculate and conidiogenous at 1-5 loci. As an historical note, the epithet *tenuissima* originally referred to conidiophores of the fungus, "*Fibrae tenuissimae*," not to the narrowly tapered conidium beaks that are characteristic of some conidia in the neotype and that now are considered diagnostic to some extent for the species-group.

This unelaborated description of typical *A. tenuissima* as a field specimen fits large numbers of field collections and initial growths on innumerable different substrates held for a few hours in a damp chamber. However, our knowledge of field or first-growth conidium morphology and sporulation patterns, and of their correlation with the same characters as they develop over a few days in axenic cultures, still remains too scanty for predictability between field and culture dish.

For classification purposes, the *Alternaria tenuissima* group is considered to comprise species that, on the field substrate in nature or under short-term (1-2d) damp chamber conditions, usually produce unbranched chains of a few to many long-elliptical conidia that taper gradually into a narrow but not truly filiform beak. Older conidia often have a primary, almost median transverse septum that appears darker and more constricting than are other transepta. Branches a few conidia long may develop as the chain reaches its maximum length. The length of tapered beaks varies greatly in young chains, sometimes equalling or exceeding the length of the spore body but usually being shorter. Some species continue to produce long, tapered beaks on essentially all spores as the chains mature with a possible 10-20 catenate units. Other members of the species-group tend to produce elongate beaks only on the first few conidia of a chain (those proximal to the conidiophore), after which narrow true beaks are absent, with short secondary conidiophores taking their place during chain formation. Conidium wall ornamentation may be lacking (as viewed at 780X), scattered but conspicuous, or sometimes evenly, closely punctulate and almost obscurant of internal septa.

Several conidia present in the type collection of *A. tenuissima* are illustrated in Fig. 94. These help to establish the appearance of the species as it sporulates in nature under unknown conditions, and yield a few bits of information useful in defining an *A. tenuissima* species-group for classification purposes. However, as noted above, the sporulation morphologies of axenic cultures derived from conidia of this commonly encountered kind are too diverse to be species predictable on the basis of the original field collections.

Examples of taxa that fit into this *A. tenuissima* species-group concept are discussed below in Alt.T&V nos. 117-122. Previous discussions of three of these are found in Alt.T&V no. 32 (Simmons 1990, as *A. tenuissima* group, species 1), in Alt.T&V no. 33 (Simmons 1990, as *A. tenuissima* grp., sp. 2), and in Alt.T&V no. 59 (Simmons 1993, as *A. tenuissima* group, species 3). The several different sporulation patterns and basic conidium morphologies characterize stable, distinguishable populations as they occur in axenic culture on V-8 juice agar.

The culture medium of choice for description and comparison in these Alt.T&V notes usually is PCA because this relatively low-nutrient medium supports good growth and sporulation of nearly all *Alternaria* isolates and because it is easily prepared from readily available ingredients. As an exception, V-8 agar is used here for the *A. tenuissima* species-group because differences in conidium morphology for component species are accentuated on this medium. Use of PCA for study of many *A. tenuissima* group members is de-emphasized because the medium encourages chain development so rapid that there is a general reduction in conidium size, with the result that the typical *A. tenuissima* characters of tapered conidia and strong median septa become of minor occurrence.

117. *Alternaria tenuissima*; representative isolate Fig. 95

Isolate EGS 34-015 (from *Dianthus* sp., U.K.; recd. March 1981 as IMI 255532) is chosen to represent my concept of typical *A. tenuissima* as it develops under conditions of artificial culture. This choice is made from among several similar isolates because the characteristics of this culturally stable strain embody those of a large portion of the isolates that fit the *A. tenuissima* spore-group template. No special significance is attached to the fact that this representative isolate and the type of the species both are from *Dianthus*.

The initial 2-3 conidia of young chains (less than 24 hrs. on original inoculum) are essentially awl-shaped or at least have a narrowly tapered upper half; only transverse septa are present in these spores, which usually do not exceed $50 \times 8 \mu\text{m}$. As additional conidia are added distally to the chain, tapered-beak production is lost; new conidia terminate abruptly in a short 1-2-celled secondary conidiophore. Colonies at 4d are dominated by unbranched chains of 6-10 conidia. (Longer chains and uncommon branching may be found in colonies aging past ca. 7d.)

Fully developed chains of *A. tenuissima* produced under standard conditions specified for these studies have patterns of sporulation and of conidium morphology of considerable diversity. This diversity, however, retains some general characteristics with group classification value, viz., the initial 1-2 and sometimes even 4-5 lowest conidia of a chain usually have only transverse septa; only one or two mature conidia in a chain have the helpfully diagnostic median, subconstricting transverse septa that are such a striking feature of field conidia; these median-constricted conidia may be ovoid with a short apical secondary conidiophore or obclavate and broadly tapered into an apical conidiophore.

Mature conidia that have only transepta reach a size range of ca. $32\text{-}45 \times 11\text{-}13 \mu\text{m}$; ovoid muriformly septate conidia ca. $32\text{-}45 \times 14\text{-}18 \mu\text{m}$; obclavate muriformly septate conidia ca. $40\text{-}60 \times 16\text{-}18 \mu\text{m}$. Conidia are medium golden brown in color and closely, obscurely to conspicuously punctulate in ornamentation.

118. *Alternaria tenuissima* group, species 1
cfr. *Alt.T&V* no. 32, Fig. 46 (Simmons, 1990)

This taxon, represented by an isolate from *Citrus* sp. (Fawcett II no. 1229K; EGS 06-187), has the group characters of unbranched chains of 10-15 conidia, of which the largest are of small to moderate size (up to ca. $40\text{-}50 \mu\text{m}$), are long-ellipsoid, and have a long tapering beak and a prominent median septum.

Elongate conidia of the taxon tend to retain production of long slender beaks in culture (typical *A. tenuissima* does not), and to be narrower, less septate, paler, longer-chained, and in general more delicate in appearance than typical *A. tenuissima*, both in 50X culture dish over-view and in slide examinations at 195X and 780X.

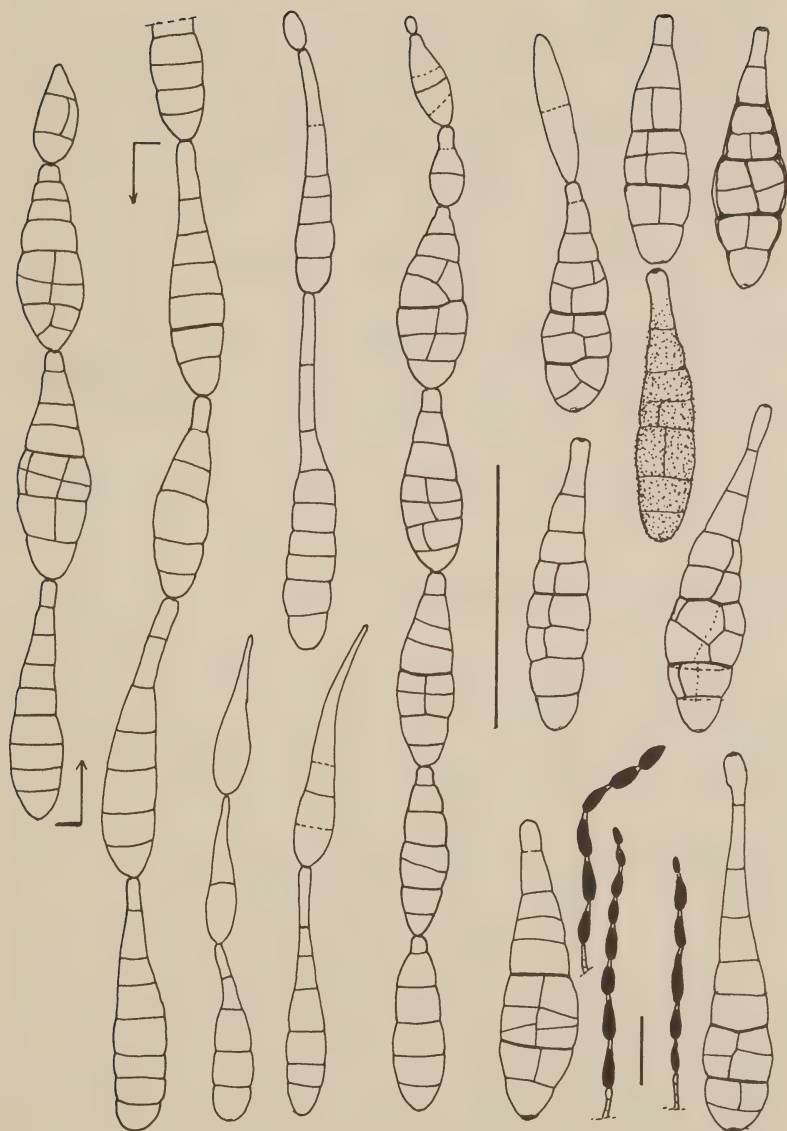


Fig. 95. *Alternaria tenuissima*: representative isolate EGS 34-015; chains of 2-3 awl-shaped conidia, lower left, less than 24hr. old; others up to 4d on V-8 agar. Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

119. *Alternaria tenuissima* group, species 2
cfr. *Alt.T&V* no. 33, Fig. 47 (Simmons, 1990)

This taxon, represented by a specimen on leaves of *Citrus sinensis* (L.) Osb. (IMI 1239; EGS 22-089), originally was segregated from typical *A. tenuissima* in order to emphasize an appreciable difference between the two in the character of beak production.

The narrowly tapered beak of typical *A. tenuissima*, when present in nature or in young culture, usually originates as a distinct apical extension of juvenile conidia; it lengthens as the spore body enlarges. In contrast, juvenile conidia of this *Citrus* inhabitant have a conical or broadly wedge-shaped apical cell that lengthens and widens into a comparatively sturdy true beak.

In the absence of an isolate of this taxon, it would be unproductive to speculate as to whether or not this beak character would persist in spores produced in artificial culture.

120. *Alternaria tenuissima* group, species 3
cfr. *Alt.T&V* no. 59, Fig. 58 (Simmons, 1993)

This taxon, represented by an isolate from *Passiflora* sp. (Aragaki no. 69; EGS 29-026), may be considered a borderline member of the species-group. Sporulation rings produced proximal to the agar substrate in culture consist of a dense turf of long, unbranched chains of conidia. Predominant conidia of these chains are narrow-elongate, up to ca. 35-50 x 10-13 μ m, tapered in the upper half but terminating in a 1-2-celled secondary conidiophore rather than in a narrowed true beak, and with the median transeptum only slightly constricted and pigmented.

Branching of conidial chains is common within 7-10d, particularly in sporulation groups borne on aerial hyphae in rings that alternate with the surface-sporulating rings. These aerial arborescent clumps of small conidia are similar in structure to those of typical *A. alternata* and thus present a complicating factor in comparison and identification if spore samples from both aerial and surface growth are intermixed in a slide preparation.

121. *Alternaria tenuissima* group, species 4 Fig. 96

A field collection and isolates from mature dry siliques of *Brassica napus* L. (rape, canola; Wingate,

Indiana, June 1989; EGS 39-096) are instructional in that they provide not only large numbers of mature conidia in place on the field substrate but also abundant young chains (3-4 conidia) on siliques held overnight in a damp chamber and dense stands of characteristically short (7-9 conidia), unbranched chains of spores in culture.

Field specimen conidia of this taxon are very similar to those of typical field conidia of *A. tenuissima*. Sporulation in culture of this *Brassica* isolate also is similar to that found in representative isolates of *A. tenuissima*. However, conidia of this canola isolate are in general smaller, both in actual measurements and in general visual impact of populations in slide preparations. This difference, notable even without resort to statistical comparison, is attributable to the significant percentage of relatively large obclavate and broadly tapered conidia (ca. 40-60 x 16-18 μ m) present in the *A. tenuissima* isolate and the near absence of this particular spore shape and size in the canola isolate.

Sporulation on the field specimen is a mixture of ovoid to long obclavate conidia with short awl-shaped to long tapering beaks and of similar spores with the beak apex converted into a secondary conidiophore. A characteristic slightly constricting median septum usually is present. Largest conidia have 7-10 transverse septa and 1-2 longisepta in a few of the transverse segments. Conidium size reaches a range of ca. 60-90 x 15-18 μ m; color is a medium yellow-tan; ornamentation is lacking or minutely punctulate.

Young chains produced on original field material held overnight in a damp chamber have 3-4 conidia, which may be narrowly tapered apically or may end abruptly in a 1-celled secondary conidiophore. Largest conidia at this stage are ca. 25-40 x 8-11 μ m.

Chains produced on V-8 agar within an initial 4-5d are unbranched and have 7-8 conidia. At this stage conidia usually do not have narrowly tapered beaks; only a small percentage of spores show enough broad taper that they might be termed obclavate (in contrast to the common occurrence of large obclavate conidia in spore populations of *A. tenuissima*). Conidia reach a size range of ca. 30-50 x 10-13 μ m; color is dilute yellow-tan; ornamentation is lacking or obvious but punctulate. Mature septation is 6-8 transverse with 1 longiseptum in a few of the transverse segments; the median transeptum usually appears slightly

darker and more constricting than other septa, but not markedly so.

As with some other representatives of the *A. tenuissima* species-group in culture, chain elongation in this taxon may continue and short branches be formed as colonies age. However, at 4-5d, chain elongation in this taxon pauses at ca. 7-8 units throughout most of the population as radial growth slows down near the limit of the culture dish.

122. *Alternaria tenuissima* group, species 5

Fig. 97

A field collection of an overwintered inflorescence scape of *Allium tuberosum* Rottler (Chinese chives; Hadley, Massachusetts, May 1981; EGS 33-200) bears ovoid *Alternaria* conidia of medium size with 1-2 constricting transepta and apical secondary conidiophores. This poor material might be given tentative place in the *A. tenuissima* group, but prediction of the kind of sporulation that might develop from it would be quite impossible.

Abundant sporulation on the field specimen under damp chamber conditions and in subsequent isolates is of a taxon that produces predominantly long, narrow, apically tapered conidia in chains (at 4-5d) of ca. 6-10 spores. Only 1-2 spores in any chain exhibit the median constricting septum character of the *A. tenuissima* group. Conidia either are relatively small (ca. 10-20 μ m long), particularly at chain tips, or fall in a size range of ca. 40-60 x 10-12 μ m. These characteristically long, narrowly elliptical or obclavate conidia strongly dominate the population; they have 7-9 transverse septa and either no longisepta or usually only 1 in a few of the transverse segments. The median septum usually is not constricting at this stage. Color is a dilute tan; wall ornamentation is lacking or minutely to conspicuously punctulate.

This taxon isolated from *Allium* sp. borders on a group of isolates that produce long unbranched chains of comparatively long, narrow, attenuate-beaked conidia that seldom produce median-constricted conidia that are considered to be characteristic of the *A. tenuissima* species-group. *Alternaria rhadina* Simmons (1993; *Alt.T&V* no. 71) is a representative of this neighboring group, which encompasses additional species not yet discussed in these notes.



Fig. 96. *Alternaria tenuissima* group, species 4: field conidia left of bar; 3 chains of young conidia right of bar produced on field substrate overnight in damp chamber; other conidia 4d on V-8 agar (EGS 39-096). Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

Summary: *Alternaria tenuissima* species-group

Type specimen: Conidium size small to moderate; conidia in chains (5-6?); conidia usually with a constricting median septum and narrowly tapered beak.

Representative: (in culture) Conidium size small to moderate; chains 6-10 units; only young conidia narrowly tapered, older obclavate and pseudorostrate; median constriction present in ca. 10% of conidia.

Group-sp. 1: Conidium size moderate; chains 10-15 units; conidia retain long slender beaks and median constriction in culture.

Group-sp. 2: Conidium size moderate; evidence of short chains; median constriction; conidium apex broadly wedge-shaped, becoming a sturdy true beak.

Group-sp. 3: Conidium size moderate; chains ca. 10 units; conidia narrow-elongate, tapered but not into a narrow true beak; median constriction slight.

Group-sp. 4: Conidium size moderate; chains 7-8 units; conidia have narrowed true beak and median constriction in nature; no true beak or strongly obclavate conidia in culture; median constriction usual in culture.

Group-sp. 5: Conidium size moderate; chains 6-10 units; conidia narrow-elongate ellipsoid to obclavate; seldom median constriction.

XVII. THE *ALTERNARIA* CHEIRANTHI SPECIES-GROUP

Several previous units of these *Alternaria* studies contain remarks on the nature of the secondary conidiophore, i.e., of the distinctive germination hypha produced by a conidium that enables production of a second-generation conidium, thus forming a chain. It is essential to maintain emphasis on this generative structure and on its difference from non-conidiogenous true beaks if the so-called chain-forming species of *Alternaria* are to be understood and rational comparisons are to be made among them.

Many species of *Alternaria* produce conidia that are simply ovoid to ellipsoid, without any sort of distally tapered portion that might be defined as a beak. If they



Fig. 97. *Alternaria tenuissima* group, species 5: 3 field conidia at lower left; 3 chains of young conidia left of bar, produced on field substrate 12hr in damp chamber; other conidia 4d on V-8 agar (EGS 33-200). Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

produce secondary conidia (some species rarely do so), it is through the agency of this secondary conidiophore, the pseudostrostrum, a morphologically distinct, new structure that may be several-celled and many microns long, or just a single short cylindrical cell, or even, at the extreme, only a conidiogenous site in the wall of a pre-existing conidial cell.

The conidia of *Alternaria cheiranthi* (Lib.) Bolle (1924) are of this erostrate sort, producing conidia with a rounded or, at most, a broadly tapered apex, but certainly without a definable beak distinct from the spore body. In nature these conidia often generate an apical secondary conidiophore of one to a few conidiogenous cells, but the original beakless spore body retains its identity. Isolates of *A. cheiranthi* readily produce short chains of conidia in culture, but here again observable beaks are only new conidiophores that have developed from apical and occasionally lateral or basal cells. The conidia have an overall robust, sturdy appearance due to the erostrate nature and often thickened walls of the conidia and to concentration of pigment in some of the septa.

Wiltshire's impression (1933) of *A. cheiranthi* was that the species is "more like a *Stemphylium* than anything else," with reference to his then nascent concept of a "*Pseudostemphylium* section" of *Stemphylium* Wallr. and to *S. lanuginosum* Harz (= *Ulocladium lanuginosum* (Harz) Simmons (1967)). He concluded, however, that the overall picture was alternarioid, primarily because of conidium chain formation, and that *Alternaria* was the best genus choice for this taxon.

Neergaard (1945), influenced not only by Wiltshire's observations but also by the frequent occurrence of secondary conidiophores, which he recognized sometimes as part of the conidium or at other times as "false" beaks, retained the taxon as a catenate *Alternaria* species. At the same time he segregated a few other taxa with quite similar sporulation and conidium characteristics into the heterogeneity of the subgenus *Pseudostemphylium* Wiltshire (1938), de-emphasizing the fact that these segregates also could sporulate in chains, though less exuberantly than does *A. cheiranthi*.

Alternaria cheiranthi is not a *Ulocladium* or a *Stemphylium* (cfr. Simmons 1967). Along with Wiltshire, I consider the species best placed in *Alternaria*, with conidium development and morphology typically erostrate and

with chain production restricted in nature and usually, though not necessarily so, in culture.

A few other *Alternaria* taxa with conidia characterized by this strongly erostrate tendency, particularly in specimens from nature, may mature with unusually dense pigmentation in septa and in some instances with abundant hyphal chlamydospores or strikingly enlarged macroconidiophores. Neergaard treated those known to him as species of *Stemphylium* subgen. *Pseudostemphylium*. All are treated here as taxa of the *A. cheiranthi* species-group, with the name of this earliest described species used as a group reference even though the name of any one of the better known taxa, such as *A. radicina*, would be equally usable.

These additional members of the species-group are the commonly encountered *A. radicina* Meier, Drechsler & Eddy (1922); the less frequently reported *A. petroselini* (Neergaard) E. Simmons (in Ellis 1976); the species known for several years as *A. ramulosa* (Sacc.) Joly (1964), now revised as *Alternaria smyrnii* (Crouan) E. Simmons (1995; *Alt. Chronology* 1867); *A. instipitata* (Preuss) Simmons (1995; *Alt. Chronology* 1848); and *A. japonica* Yoshii (1941; syn. = *A. raphani* Groves & Skolko [1944]). In addition three new taxa are circumscribed. A key to these nine members of the *A. cheiranthi* species-group now recognized follows *Alt. T&V* 131.

Classification of the six previously named species in this particular *Alternaria* group has bedevilled most students of the genus, primarily because of the essentially erostrate nature of the conidia and the tendency of conidia to remain solitary or for chains of conidia to be short and of condensed appearance and sometimes tardy formation, thus contrasting with an overly generalized concept of *Alternaria* taxa as ready producers of chains of beaked conidia or of solitary, long-beaked conidia.

Wiltshire (1933) hesitated generically over *A. cheiranthi* but finally opted for *Alternaria*. Neergaard (1938) first tried *Thyrospora* Tehon & Daniels (1925) for the very similar *A. radicina*, then moved on (1939) to *Stemphylium* Wallr. (1833) after Wiltshire (1938) established the synonymy of *Thyrospora* and *Stemphylium*. At this time Neergaard chose "*Stemphylium* (subgenus *Pseudostemphylium* Wiltshire)" for disposition of his *S. radicinum* (Meier et al.) Neerg., because he perceived a resemblance between *A. radicina* and the *Stemphylium lanuginosum* Harz (1871) that Wiltshire treated in discussing his "group/section" *Pseudostem-*

phylium. (Wiltshire did not discuss *A. radicina* in his classic studies of 1933 and 1938.) Neergaard did not distinguish generically between *A. radicina* and fungi now assigned to *Ulocladium* Preuss (cfr. Simmons 1967). Subramanian followed the lines of reasoning developed by Wiltshire and Neergaard and published *Pseudostemphylium* Subram. (1961), typified by the fungus now known as *Ulocladium lanuginosum* (Harz) Simmons (1967) and including the itinerant *A. radicina*.

Over the past 40 years or so I have entertained all of the misgivings expressed by these authors in their systematic relocations of *A. radicina*, *A. cheiranthi*, and similar species in and out of *Alternaria*. Ovoid, moderately dark-septate, non-beaked conidia are typical of all species in the group, and a case perhaps could be made for segregating them as *Macrosporium* Fr. (type *M. cheiranthi* (Lib.) Fr.). They can be defined fairly well as a species-group, but their generic segregation outside *Alternaria* would have only a weak taxonomic and practical basis.

Fortunately, excellent isolates exist of all but one (*A. instipitata*) of the species mentioned above for this group. The decision to retain all of them in *Alternaria* is based on field material and, when possible, young cultures, and on the similar patterns of conidiophore production, sporulation, and conidium morphology that exist before species differences obscure the underlying similarities.

Intentionally omitted from this group discussion are several *Alternaria* species also with relatively large erostrate conidia but whose walls and septa do not become strongly pigmented and whose conidiophores do not become coarsely macronematous (e.g., *A. triticina*).

123. *Alternaria cheiranthi* (Lib. : Fr.) Bolle (1924), Meded. Phytopathol. Lab. Willie Commelin Scholten 7: 43. Fig. 98

= *Helminthosporium cheiranthi* Libert, in Desmazières, Pl. Crypt. France, Fasc. V, no. 213. 1827. [edit. in sched.]

= *Macrosporium cheiranthi* (Lib.) Fr., Syst. Mycol. 3(2): 374. 1832.

= *Alternaria cheiranthi* (Lib.) Wiltshire, ex Neergaard, Danish Species of *Alternaria* and *Stemphylium*, p. 212. 1945.

~ *Puccinia cheiri* T. G. Lestiboudois, Botanographie Belg., p. 132. 1827.

Macrosporium (*Helminthosporium*) *cheiranthi* (Lib. : Fr.) Fr. is the type of *Macrosporium* Fr. (1832), a choice mentioned by Berkeley (1845) and Wiltshire (1933), listed by Hughes (1958), and followed by Simmons (1964) in his proposal to conserve *Alternaria* Nees over *Macrosporium* Fr. As long as *A. cheiranthi* is considered congeneric with *A. alternata* (Fr. : Fr.) Keissler, which I do, the genus name *Macrosporium* must remain in synonymy with *Alternaria*. If ever the Libert fungus were differentiated authoritatively from *A. alternata* at the genus level, *Macrosporium* would come into legitimate use again for *M. cheiranthi* and similar species (and lead to a nomenclatural mess of ghastly proportions).

There has been general agreement among *Alternaria* specialists that Bolle (1924) was studying a species other than *Helminthosporium cheiranthi* Libert when she established a new name combination in *Alternaria*. (Her published illustration is of conidia very similar to those of *A. tenuissima*.) Ramsbottom (1933) argued, without permanent nomenclatural effect, that since two species were involved there must therefore be two names; one would be related to Bolle's work and her misidentified fungus, the other to Wiltshire (1933) and the combination *A. cheiranthi*, because Wiltshire had studied the correct fungus.

Neergaard (1945) headed his treatment of this species "*Alternaria cheiranthi* (Fr.) Bolle sensu Wiltshire 1933" but added "According to the principles [Neergaard] advocated in [his] section on Nomenclature, the fungus has to be designated as *Alternaria cheiranthi* (Libert) Wiltshire." Joly (1964) attributed the combination to Wiltshire.

Wiltshire himself (1933) had not fallen into such a trap of confusing taxonomic identity with nomenclatural procedure; he attributed the authority of the name correctly (for 1933) and explained the taxonomic situation succinctly by writing "*Alternaria Cheiranthi* (Fr.) Bolle, excluding [her] specimen."

It is noted in passing that an attribution *A. cheiranthi* "(Berk.) Baela" [Bolle?] exists in the Japanese literature (e.g., K. Hara, 1954). Also, *A. cheiranthi* "(Lib.) Elliott" appears on some herbarium packets, presumably with reference to J. A. Elliott (1917), although Elliott did not actually make such an epithet transfer when he suggested that *Macrosporium cheiranthi* Fr. and some other species of *Macrosporium* "undoubtedly belong to *Alternaria*."

Wiltshire's study (1933) of *A. cheiranthi* can scarcely be improved. He worked from a portion of the type collection (K; EGS 11-005), collected, isolated and described living material, provided precise illustrations and diagnostic guidance, and correctly attributed the authority of the name in *Alternaria*. A few of his observations need to be abstracted and emphasized here along with some of my own comments in order to place the species in a position of comparison with the rest of the genus, for Wiltshire at the time was discussing only the five early 19th century foundation species of *Alternaria* and *Macrosporium*, only one of which is of the *A. cheiranthi* species-group.

Alternaria cheiranthi can be found in almost any extensive planting of the wallflower *Cheiranthus cheiri* L. (Brassicaceae). Leaf, stem, and seedpod lesions bearing lush stands of olive green sporulation can be spotted readily, for example, in English garden borders, where the wallflower commonly is grown. The fungus is so prevalent in plantings that wallflower seed in practically any garden-shop packet will yield *A. cheiranthi* colonies under damp chamber conditions (e.g., EGS 41-188 etc., from seed purchased in U.S.A., spring 1994, with Italy as "country of origin").

Wiltshire noted, as have I, that the species is known until now only on wallflower. He reported (1933) examination of "*Macrosporium cheiranthi*" exsiccata [K] representing several other host plants and concluded that the fungus was misidentified in each instance. Repeating some of his examinations, I have reached the same conclusion.

Wiltshire's comments on the type specimen, his cultures (on clear maize meal, potato-dextrose, Dox, and bean agars), the microscopic details of sporulation, and especially his illustrations are models of observation. Only the character of conidium size given by him, 21-97 x 13-32 μ m (type collection) and 27-87 x 14-28 μ m (his 1930 specimen) needs clarification, for the maximum lengths cited are exceptional and, for comparison purposes in the species-group, misleading.

Re-examination of conidia from the type, and comparison with Wiltshire's illustrations, show that his measured length maxima are for conidia that have gone beyond the rather regular bilateral symmetry of most spores into a somewhat unrestrained pattern of cell division and swelling (Wiltshire: "secondary growth"; "irregularly shaped conglomerations of cells") that gives a false picture of the

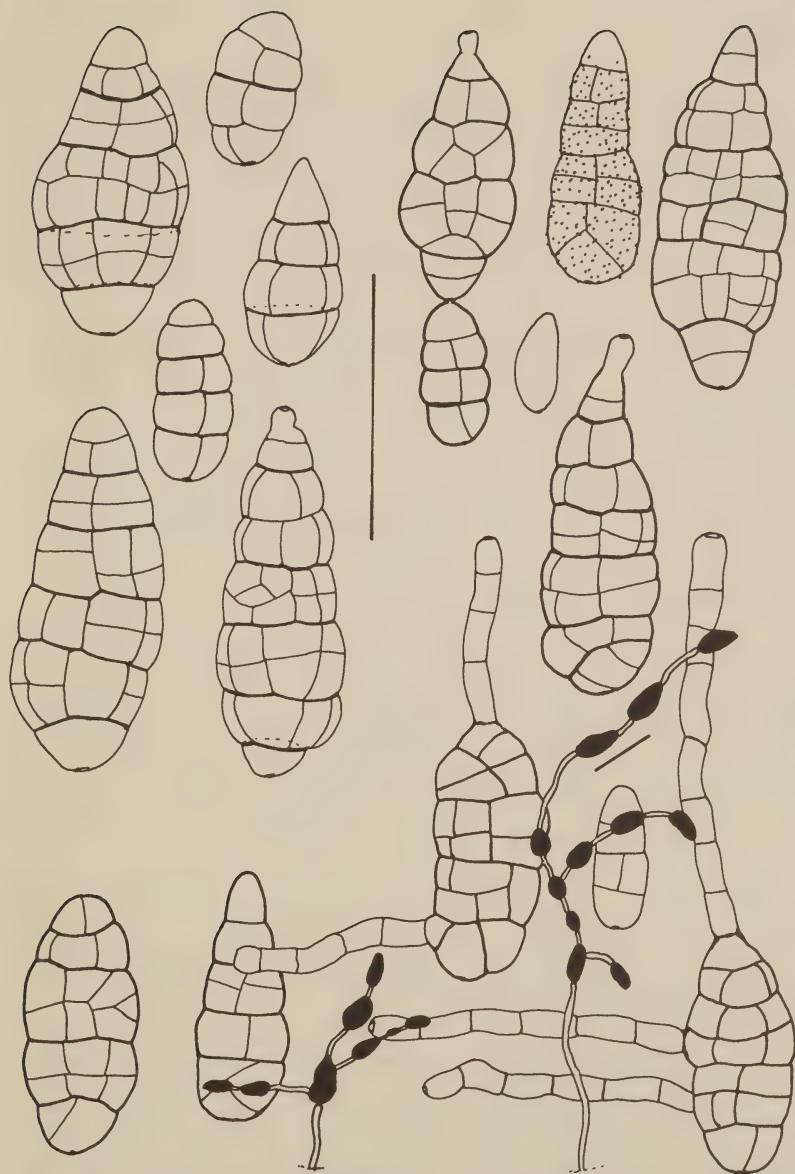


Fig. 98. *Alternaria cheiranthi*: 6 conidia left of bar ex lectotype (K; EGS 11-005); remainder (EGS 41-188) with long secondary conidiophores ca. 10d PCA, others 4d V-8. Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

conidium population and of its mature but not overdeveloped dimensions.

Maximum conidium length before secondary cell development, calculated from Wiltshire's illustration, is ca. $85\mu\text{m}$ for the type and $80\mu\text{m}$ for his own field material. My measurements from type are essentially the same. Neergaard (1945) gives a length range of $15.0\text{-}64.5\mu\text{m}$ for conidia produced experimentally on *Cheiranthus* seedlings.

This clarification of maximum, pre-overdevelopment size is not meant to obscure the fact that "secondary" septation and enlargement are prominent characters of *A. cheiranthi* conidia, both in nature and in culture. The point is that comparison of commonly overdeveloped *A. cheiranthi* conidia with conidia of other taxa that do not have this tendency can scarcely be considered valid or helpful in classification of the group. The observation serves as a warning that it is not unknown for an unexplained discrepancy of ca. 15%, such as that between Wiltshire's stated maximum length and measurements from his illustrations and my slide preparations, to have served some authors as reason for otherwise unjustified proposal of new species in *Alternaria*.

Conidiophores of *A. cheiranthi* are produced in dense stands both in nature and in culture. Sporulation may be from a single apical site (usually) or a few successive sites at geniculations in conidiophores that vary in length up to $500\mu\text{m}$ or more $\times 5\mu\text{m}$. Conidia usually are solitary in field lesions, although short secondary conidiophores on some conidia indicate that short chains, probably of only 2-3 spores, are formed. Chain formation dominates the sporulation picture in culture. The pattern is of the initial conidium on a primary conidiophore giving rise to 1-3 secondary conidiophores from which solitary conidia or chains of 2-6 develop. The 50X appearance is of irregularly branched sporulation groups of up to 8-12 dark, ovoid conidia connected by very conspicuous, narrow, often quite long secondary conidiophores.

Conidia produced in culture (PCA, V-8) are broadly ellipsoid or ovoid; enlarge to ca. $50\text{-}70 \times 20\text{-}23\mu\text{m}$, although the bulk of fully developed conidia are near the lower end of this range; have as many as 8-11 complete or partial transverse septa, of which 3-5 are darker and thicker than others, and 0-5 longitudinal septa in the broadest transverse divisions. Conidia are medium chestnut brown with the color intensified in edge-view septa.

Conidium walls are constricted at most of the transepta, and smooth or very minutely punctulate or eventually distinctly rough in age.

Secondary conidiophores arise from otherwise unaltered terminal cells as well as from any other cell of the spore body, with the transition between conidium and new conidiophore abrupt and well defined. Secondary conidiophores may be simple or geniculate and conidiogenous at 2-3 loci; they are medium brown, distinctly septate, and variable in size to at least $150 \times 5 \mu\text{m}$.

124. *Alternaria instipitata* (Preuss) Simmons (1995), Mycotaxon 55: 23. Fig. 99

= *Septosporium instipitatum* Preuss, in J. Sturm's Deutschlands Flora, III. Abt., Bd. 6(25-26): 23. Tab. 12. 1848.

= *Macrosporium instipitatum* (Preuss) Lindau, in Rabenhorst's Kryptogamen-Flora, I, 9(108): 229. 1908.

Preuss described a growth of geniculate conidiophores and associated brown, thick-walled, muriform conidia on conifer wood. He noted the absence of a polar extension on the oblong, rounded to angular spores, "*ungestielt* Zellenspore" (stipeless or beakless), and devised the epithet *instipitatum* to emphasize this difference from what he considered normal for species of *Septosporium*. The correct orientation of the broad-based conidium to conidiophore is easy to misconstrue, as Preuss apparently did, for the basal pore usually is difficult to see within the contour of the thick, dark conidium wall.

Conidia of the type specimen (B; EGS 17-053) are good representatives of the *A. cheiranthi* species-group. They are broadly ovoid with either a rounded or a bluntly tapered apex, medium golden brown, to ca. $33\text{-}45 \times 18\text{-}22 \mu\text{m}$, with as many as 7 complete or partial transepta and 2-3 longitudinal or oblique septa in the largest transverse compartments. Largest conidia are slightly constricted at 2-3 of the primary septa. No secondary conidiophores are evident on conidia examined from the field type. External walls are relatively thick, dark, and minutely ornamented. Conidiophores are thick-walled, closely septate, simple or 2-3 geniculate, and often up to ca. $100 \times 8 \mu\text{m}$. *Alternaria instipitata* is not known to me in culture or in other specimens. Wood as a substrate is unusual for an *Alternaria* but not unique to this specimen.

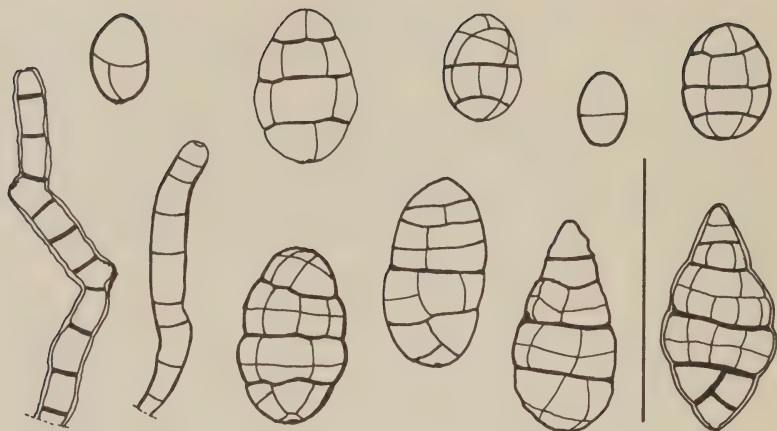


Fig. 99. *Alternaria instipitata*: conidia and conidiophores ex holotype (B; EGS 17-053). Bar = 50 μ m.

125. *Alternaria radicina* Meier, Drechsler & Eddy (1922),
Phytopathology 12: 164. Fig. 100

- = *Thyrospora radicina* (Meier et al.) Neergaard,
Botan. Tidsskr. 44: 361. 1938.
- = *Stemphylium radicinum* (Meier et al.) Neergaard,
[4.] Aarsberetn. J. E. Ohlsens Enkes Plantepat.
Lab. 1. April 1938—31. Marts 1939. p. 14. 1939.
- = *Pseudostemphylium radicinum* (Meier et al.) C. V.
Subramanian, Current Science 30: 423. 1961.
- = *Macrosporium daucinum* Yatel, Mikrobiol. Žurn. Akad.
Nauk, Ukrainian SSR (Kiev), 5: 206. 1938.

Alternaria radicina, associated originally and now traditionally with a semi-dry black rot of carrot crown and root, has been studied, described, and illustrated almost entirely from cultured isolates or from seeds held under damp-chamber conditions. However, notices of the fungus on carrot and other apiaceous hosts (parsley, celery, celeriac, parsnip) are arguable if a report is based on black-rot field or storage lesions rather than on microscopic evaluation of the fungus present, as is discussed below.

There are very few voucher specimens extant with putative *A. radicina* sporulation in place on infected carrot roots. These few, along with available cultures or conserved dried specimens of them, give a broader picture of the kinds of alternarioid morphologies associated with the taxon name and the black-rot condition than the original phytopathology and taxonomy research paper of Meier, Drechsler, and Eddy (1922) and an early pertinent paper by Lauritzen (1926) would lead us to expect.

The only material of *A. radicina* that appears to have a connection contemporary with the two 1920's studies is isolate ATCC 6503 (EGS 03-145), which originated with J. I. Lauritzen: "Lauritzen . . . or Eddy probably found the first specimen of this fungus on carrots. [Lauritzen] . . . was closely associated with Meier and Drechsler. #6503 can safely be assumed to have been derived from the type specimen of the fungus." (in litt. ATCC Director F. A. Weiss to E.G.S., January 1957).

ATCC 6503 earlier had been strain 5350 at BPI, USDA, Beltsville, Maryland, which "years ago . . . operated the Fungus Section of the American Type Culture Collection. . . . I believe that the original type culture [of *A. radicina*] is involved." (in litt. J. A. Stevenson, National Fungus Collections, BPI, to E.G.S., December 1956).

My approaches to Stevenson and Weiss followed an opinion of Drechsler that "it seems very probable that no material of the species was deposited anywhere. My own participation in the description [including the original type illustrations] of the fungus was limited to observations made on pure cultures in 1921. . . . Had the 'type' concept of species then [1922] prevailed in Mycology, Meier or Eddy would almost certainly have placed abundantly sporulating carrot material either in the herbarium at Washington or in the herbarium of the New York Botanical Garden" (in litt. C. Drechsler to E.G.S. December 1955).

To clarify the historical record and the secondhand information on the existence of type or ex-type *A. radicina*, it is noted that the type work reported in 1922 was carried out partly in USDA Washington, D.C., laboratories and partly in the laboratory of the Brooklyn Botanic Garden, Brooklyn, N.Y. (Meier et al., 1922). No pertinent field specimen has been found in NY or in BKL (BKL now incorporated in BPI). This leaves only the Lauritzen-related isolate as problematically related to the original cooperative studies and to Drechsler's contribution of the

type description and illustrations.

ATCC 6503 (Lauritzen) remains in stable condition and, importantly after 70 years, produces conidia whose form, color, septation, and dimensions are the same as those described by the original authors. These facts allow us to designate a dried-down culture preparation of this isolate as neotype of *Alternaria radicina* Meier et al., deposited in BPI (EGS 03-145). Lectotypification is ruled out because no original material is known to have been conserved.

The type description, based on cultures, speaks of straight, clavate, ellipsoid, obovoid, or turbinate conidia borne closely, successively, and singly in a clump of 2-3 at the apex of conidiophores of variable lengths or tardily in short chains of 2 conidia. Conidia are light to dark brown to dark olivaceous, 3-8 transversely septate, mostly 1-, infrequently 2-longiseptate in all but basal and apical segments, $34-51 \times 10-22\mu\text{m}$.

In view of the considerable variation in morphology, particularly conidium size and chain formation, of conidia in conserved and living material discussed in the *A. radicina* literature (e.g., Groves and Skolko 1944; Neergaard 1945; M. B. Ellis 1971), it is noteworthy that the type authors included observations on conidia produced on at least three different culture media, viz., carrot tissue, potato-dextrose agar, and tap water agar. Conidia developed on carrot reached a range of $34-51 \times 17-20\mu\text{m}$; on tap water approximately as on carrot, with a maximum of $64 \times 22\mu\text{m}$; on pda "spores usually measure considerably less." Cultures on carrot and pda did not produce chains; those on tap water agar sometimes produced chains of 2 conidia.

Neergaard (1945, p. 343) points out a disconcerting discrepancy between the type description conidium lengths (max. $51\mu\text{m}$, up to $64\mu\text{m}$ on tap water agar) and the $80\mu\text{m}$ length of the longest conidium in Drechsler's illustration, as calculated from the specified enlargement of 535X. A modern working concept of the taxon is weakened when the original authors give a maximum conidium length of $51-64\mu\text{m}$ (depending on medium), Neergaard gives lengths up to $75\mu\text{m}$ (but does not illustrate any longer than $63\mu\text{m}$), Groves and Skolko (1944) cite and illustrate a maximum of $73\mu\text{m}$, and M. B. Ellis (1971) gives and illustrates a maximum of $57\mu\text{m}$. My own measurement of $51\mu\text{m}$ max. for ex-neotype conidia (PCA) matches Drechsler's on carrot.

These differences cannot be explained without resort to parallel cultures from all authors, which now is not possible. The customary explanation, viz., differences in substrates, culture conditions and media, is justifiable in part but not entirely, for there exist isolates from carrot black rot other than the ex-neotype that also have conidia in the small size range seen in the type (e.g., Schol-Schwarz's CBS 109.58; EGS 16-062). Equally reassuring as to the validity of the type measurements is the fact that mature conidia in my own cultures ex-neotype (PCA, 10 days) reach a maximum range of 40-51 x 13-17 μm . Since my measurements are so nearly the same as those of the type authors, it seems to me that Neergaard's perceived discrepancy between Drechsler's direct measurements and those of his illustration is more likely an error in reduction/enlargement calculations in publication than a miscalibration of his microscope ocular scale.

While retaining the original concept of *A. radicina* as presented in the Meier et al. paper and illustration and supported by the extant ex-neotype culture, it is essential to emphasize that "maximum conidium size" in *Alternaria* can be a misleading species character. This is especially true unless a high percentage of conidia in a mature colony (plate colony growth practically ended) actually reach the maximum range so frequently used in strain and species comparisons.

For *A. radicina*, the maximum lengths cited by several authors (as above) actually represent a minute portion of the conidium population. The dominant mature conidium form and size in all identifiable isolates known to me are broadly ellipsoid or ovoid, 42-50 x 18-25 μm (l/w 2.0-2.3), rather than the exceptional, more narrowly ellipsoid ones, 50-63 x 15-20 μm (l/w 3.0-3.3), that can be found only in small numbers in the most stable modern isolates of the species.

The dominant spore form of *A. radicina*, as illustrated by the several authors cited, yields l/w ratios near 2.0 (Groves and Skolko), 2.0 (Neergaard), and 1.8 (Ellis). These are the spore form and proportions that confront the eye in a slide mount, not the maximum-length examples, which must be searched for. (NB: sporulation on V-8 colonies has a greater conidium length range, up to ca. 75-80 μm , than is found on PCA under the same growth conditions.)

The ex-neotype isolate of *A. radicina*, although it

remains culturally stable and still produces conidia identical with those of the type description, is not a good representative of the taxon as it is known in numerous isolates from black rot tissue and from carrot seeds. Drechsler (in litt. cit.) remarks that "the fungus produced spores on agar plates very sparingly." This poverty of sporulation, mostly on aerial hyphae, continues in current cultures ex-neotype, in marked contrast to the very abundant surface and aerial sporulation of all the more recent isolates at hand.

An excellent representative isolate, which is culturally stable and strongly conidial, is EGS 39-001, isolated March 1987 from packeted carrot seed that originated in France.

This and other stable isolates produce essentially no non-sporulating hyphae above the agar surface. Abundant but uncrowded, erect conidiophores originate in a radiating network of well-defined subsurface and surface hyphae. Conidiophore length is variable, generally ca. 20-80 μ m, but also in the 200-300 μ m range, and even reaching many multiples of 100 μ m when they elongate into an aerial network. Simple or branched conidiophores of short to medium length generate solitary apical conidia or, very commonly, clumps of single conidia at 2-4 closely geniculate, almost knobby apical extensions. Production of a secondary conidium, forming a chain, is so rare in PCA colonies (ca. 10d) as to seem an aberration (perhaps only 1 per slide mount of 1000's).

An open aerial network of dark hyphae forms well above the surface sporulation. These aerial hyphae are fertile, indeed sometimes, perhaps always, are simply very long arching surface conidiophores that entangle into an aerial pseudo-network. Short lateral conidiophores arise at well-separated intervals on aerial hyphae; each usually bears a single spore, with 2-3 being exceptional.

Conidia initially are short ellipsoid or ovoid. As is true with many dictyosporic hyphomycetes (*Alternaria*, *Stemphylium*, *Ulocladium*), conidium enlargement follows two different patterns, with full development either relatively long and narrow or relatively short and broad. In *A. radicina* the population of short-broad, ovoid or obovoid conidia far outnumbers the percentage of longest, narrower spores. A noteworthy character of large numbers of initially ellipsoid conidia is subsequent median or supramedian enlargement that results in an obovoid shape rather than



Fig. 100. *Alternaria radicina*: conidia and conidiophores ex representative isolate EGS 39-001 (7d PCA). Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

in the commonly ovoid one of so many *Alternaria* taxa. In this case the basal cell remains essentially unenlarged beyond its late juvenile size. Both *A. smyrnii* and *A. petroselini* of the *A. cheiranthi* species-group exhibit this same obovoid character in a noticeable portion of their conidia produced in culture.

Fully developed conidia in the short-broad component of *A. radicina* populations (PCA, 10d) reach ca. $42\text{--}50 \times 18\text{--}25\mu\text{m}$ ($l/w = 2.0\text{--}2.3$), with 4-5(-6) transepta and 1-3 longisepta in any or all but apical and basal segments. Conidia that develop and mature in the long-narrow form reach ca. $50\text{--}63 \times 15\text{--}20\mu\text{m}$ ($l/w = 3.0\text{--}3.3$), with 7-8 transverse septa and 1-2 longisepta in most of the transverse segments. It is extremely rare that a longitudinal septum forms in the apical cell; I have never seen one in a basal conidium cell of *A. radicina* produced under stated culture conditions. Conidium color begins as a clear, dilute yellowed tan and develops to medium tawny brown or a darker cinnamon. Septa are well defined and darker than outer walls, but are not remarkably thickened.

* * * * *

Two other taxa of the *A. cheiranthi* species-group that occur on *Daucus carota* merit separate discussion, as follows.

126. *Alternaria atrocariis* Simmons, sp. nov. Fig. 101
(Etym.: *L. atra* + *caries*, of a black rot)

Conidiophora distincta, *grossa*, *geniculata*, $20\text{--}175 \times 10\text{--}12\mu\text{m}$. *Conidia solitaria vel brevicatenata*, in maturitate late ovoidea vel ellipsoidea, *erostrata*; nec ad ca. $50\text{--}60 \times 25\text{--}38\mu\text{m}$ (5-7 transeptata) et ad ca. $90\text{--}100 \times 30\text{--}37\mu\text{m}$ (ad 10-12 transeptata); translucide flavobrunnea vel fulvobrunnea, *laevia*, *transeptis atrobrunneis*. *Habitatio typi in radice Daucus carota L. subsp. sativus* (Hoffm.) Arcang., Wye, Kent, U.K. Holotypus: IMI 991, lectus W. M. Ware, 6 Dec. 1938 (EGS 22-008).

Most living isolates and dried culture vouchers that originated from carrot black rot can be identified with the representative strain of *A. radicina* discussed above if the vagaries of different media, culture conditions, and stability of isolates are kept in mind. However, the carrot black rot specimen cited as holotype for *A. atrocariis* has conidia that are strikingly larger than any known for *A. radicina*.

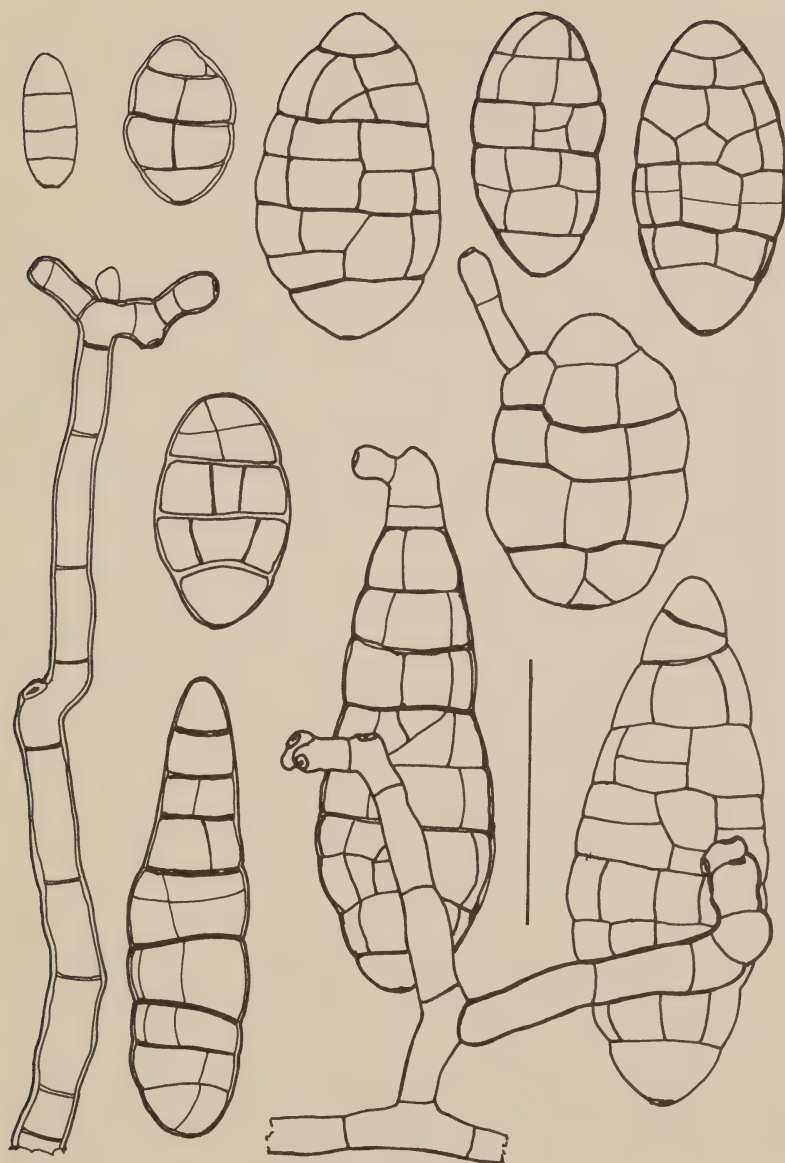


Fig. 101. *Alternaria atrocariis*: conidia and conidiophores ex holotype (IMI; EGS 22-008). Bar = 50 μ m.

This unique specimen is of special interest in that sporulation already was in place on the vegetable taproot, as offered for sale in a market. Handling and storage conditions previous to marketing are unknown, but are presumed not to have been markedly different than those of a cool damp-chamber or of cool storage conditions under which *A. radicina* commonly develops.

My own experience with market carrots with blackened crown or root tissue (e.g., EGS 13-034) held in damp chamber conditions is that they have yielded large numbers of pale, broadly ellipsoid conidia and subsequent isolates indistinguishable culturally and microscopically from other stable strains of *A. radicina* at their well-pigmented maturity. The IMI 991 holotype specimen of *A. atrocariis*, though with non-beaked conidia of the *A. cheiranthi* species-group, differs markedly in its greater conidium size, increased septation, greater wall thickness, and grosser conidiophore structure than is known in *A. radicina*. The specimen is not identifiable with any other known taxon of the *erostrate-conidium* species-group.

The original *A. atrocariis* substrate of black-rotted carrot tissue bears abundant growth of dark, thick-walled hyphae, conidiophores and conidia. Primary conidiophores are discrete, massive, geniculate at 1 or more successive sporulation sites, sometimes branched at apex, medium tawny brown, 20-175 x 10-12 μ m. Juvenile conidia are short-ellipsoid, becoming broad-ovoid at the 3-4-transeptate stage (ca. 30-45 x 18-25 μ m) with conspicuously thick walls and transepta throughout development. Mature conidia retain a broadly ovoid or ellipsoid, *erostrate* shape, become 5-12 transeptate with 1-3(-4) longitudinal septa in most of the transverse segments, are ca. 50-60 x 25-38 μ m for a large percentage of conidia with 5-7 transepta, and ca. 90-100 x 30-37 μ m for an equally large percentage that reach the highest degree of septation. Conidia appear smooth at all stages of development; color deepens from initial clear yellowish brown to medium tawny brown with most transverse and some longitudinal septa a dense brown.

Most conidia remain solitary, but others produce 1- few secondary conidiophores from lateral or basal, occasionally apical cells. Primary transverse septa usually are as thick as the outer wall and are moderately constrictive; secondary transverse and most longitudinal septa are less likely to be as conspicuously thick or as dark as primary and outer walls.

In contrast to some comparable conidium characters of *A. radicina*, conidia of *A. atrocariis* enlarge at or below the median and thus typically never become obovoid; the basal conidium cell sometimes becomes longiseptate; and conidium size ranges are greater for all spore shapes.

127. *Alternaria carotiincultae* Simmons, sp. nov. Fig. 102
(Etym.: *L. carota* + *inculta*, of wild carrot)

Ex culturis in agaro PCA descripta. Conidiophora distincta, erecta, vulgo ca. 30-60 x 6.5µm, ad 1-4 locos conidiogenos, aut longissima, aëria, breviramosa, spurie reticulata. Conidia erostrata, solitaria vel 2-3(-4) catenata; nec ovoidea, ad ca. 40-60 x 20-23µm (5-7 transeptata), et ellipsoidea, ad ca. 65-80 x 15-20µm (8-11 transeptata); translucide flavobrunnea vel umbrina, laevia. Habitatio typi in foliis moribundis Daucus carota L., IX-1968, prope Columbus, Ohio, U.S.A., coll. E. G. Simmons 26-010. Typus: partes ex cultura EGS 26-010 desiccatae et in BPI (holotypus) et saltem in IMI (isotypus) conservandae.

Meier, Drechsler and Eddy reported in their early study of *A. radicina* (1922) that they had not succeeded in finding natural infections of that species on carrot foliage in the numerous fields available to them. Artificial inoculations of leaves were successful and devastating, but examination of extensively collected, naturally wilted and yellowed leaves invariably yielded the very different filament-beaked "*Macrosporium carotae* Ellis & Langlois" (= *Alternaria dauci* (Köhn) Groves & Skolko).

Grogan and Snyder (1951) reported *A. radicina* (well distinguished from *A. dauci*) causing foliage blight of carrot under natural conditions in California vegetable fields. (I have not seen material related to that report.)

I am not aware of any report of *A. radicina* on wild *Daucus carota* L. (Queen Anne's lace) except for one of my own, listed in W. B. Cooke (1973) as a collection made during the 1968 Ohio Foray of the Mycological Society of America. The report, however, is in error, in that a fungus (EGS 26-010) easily isolated from wilted brown leaves, though of the erostrate-conidium species-group, is in hindsight a distinguishable taxon, proposed here as a new species.

Culturally (PCA, 10d) *A. carotiincultae* is very similar to stable isolates of other taxa of the *A. cheiranthi* species-group: a radiating open network of fertile

surface and subsurface hyphae; uncrowded, strong, erect conidiophores; and an open aerial network of fertile hyphae or long, enmeshed conidiophores with short side branches bearing solitary or small clumps of dark conidia. Differentiation of *A. carotiincultae* from other taxa of the species-group, particularly from somewhat similar *A. radicina*, thus depends on characters of sporulation pattern and conidia.

Chain formation involving 2-3(-4) conidia is widespread throughout *A. carotiincultae* cultures and is easily detectable at 50X. Secondary conidia typically are generated from secondary conidiophores so short as to be little more than sporogenous sites in otherwise undifferentiated apical cells or, at most, morphologically detectable structures 1-4(-5) x 2-3 μ m. In contrast, production of secondary conidia in stable isolates of *A. radicina* is extremely rare.

Conidia of *A. carotiincultae* are either ovoid, 40-60 x 20-23 μ m, with 5-7 transepta and 1-3(-4) longisepta in some segments, or ellipsoid, 65-80 x 15-20 μ m, with 8-11 transepta and 1-2(-3) longisepta in some of the transverse segments. They darken from a translucent yellowish brown to a medium dull brown, have smooth walls, and are distinctly constricted at several well-defined, slightly darker primary transepta.

Conidia of *A. carotiincultae* show practically no tendency to become obovoid, i.e., with mature width greater above the middle, as is characteristic of a high percentage of *A. radicina* conidia. *A. petroselini* conidia, although they may to a limited extent reach maximum lengths equal to those of *A. carotiincultae*, typically and in more recent representative cultures are mostly broadly ovoid or ellipsoid in lengths well below the maximum found in a colony. In contrast, *A. carotiincultae* conidium populations have a high percentage of long ovoid to long obclavate conidia at or near the maximum length range, along with the accompanying high percentage of mature, shorter ovoid spores.

Alternaria carotiincultae in culture lacks the characters of prominent, elongate secondary conidiophores (as seen in *A. cheiranthi* and *A. japonica*), prominent chains and clumps of hyphal chlamydospores (as found in *A. japonica*), and massive primary conidiophore clumps and related basal cell aggregates (as found in *A. smyrnii*).

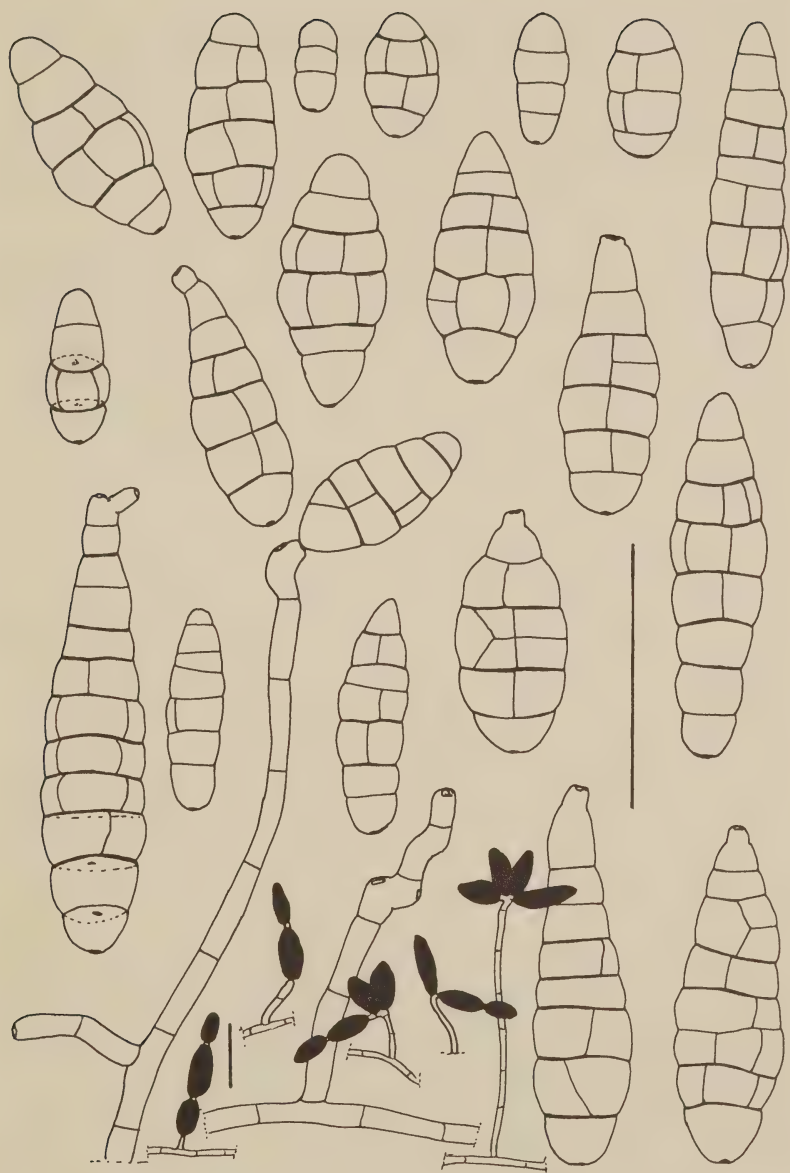


Fig. 102. *Alternaria carotiincultae*: conidia and conidiophores, ex-holotype isolate EGS 26-010 (10d PCA). Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

128. *Alternaria petroselini* (Neergaard) Simmons, in M. B. Ellis (1976), More Dematiaceous Hyphomycetes, p. 417. Fig. 103

= *Stemphylium petroselini* Neerg., Zentralbl. Bakt., 2 Abt., 104: 411. 1942b.

= *Stemphylium radicinum* (Meier et al.) Neergaard var. *petroselini* (Neergaard) Neergaard, Danish Species of *Alternaria* and *Stemphylium*, p. 357. 1945.

In the early 1940's Neergaard proposed to segregate an *Alternaria* pathogen of parsley cultivars (*Petroselinum crispum* (Mill.) Nym.) from the somewhat similar *A. radicina*, found primarily on carrot. At that time he maintained both taxa in the genus *Stemphylium*, as indicated above in the synonymy for *A. petroselini*. Primary diagnostic characters were given as differences in host susceptibility in experimental inoculations and a perception of *A. petroselini* as generally having somewhat larger spores than *A. radicina*.

Neergaard's type material of *A. petroselini* (CP; EGS 11-062), as growth developed from seeds in a seed germinator, and one of his isolates (CBS 112.41; EGS 06-196) are extant. Both are from seed of rooted parsley (*P. crispum* 'Tuberosum') and are, I believe, of the same taxon, although the type dates from December 1940 and the isolate from April 1941. Conidia of the type (Fig. 103) are all short-broad ovoid to subsphaeroid, max. $47\mu\text{m}$ long. These would yield relatively little information as to their possible identity with or distinctness from isolates from other sources were it not for the Neergaard isolate (Fig. 103), which exhibits a range of conidium morphology from the subsphaeroid of the type ($l/w = 1.4$) to the longer ellipsoid emphasized in the type description and illustration ($l/w = 2.4-3.0$).

Describing and identifying other specimens and isolates of *A. petroselini* or of similar taxa from parsley present the same problems encountered with *A. radicina* (see Alt.T&V 125), namely, the difficulty of correlating their sporulation characteristics with published descriptions (especially conidium dimensions) and illustrations. For *A. petroselini*, the significant literature is Neergaard (1945) and M. B. Ellis (1976).

Neergaard cites conidium lengths up to $82\mu\text{m}$ for one of his isolates cultured on tubed seedlings of rooted parsley ($96\mu\text{m}$ on seedlings of leaf parsley), but bases his

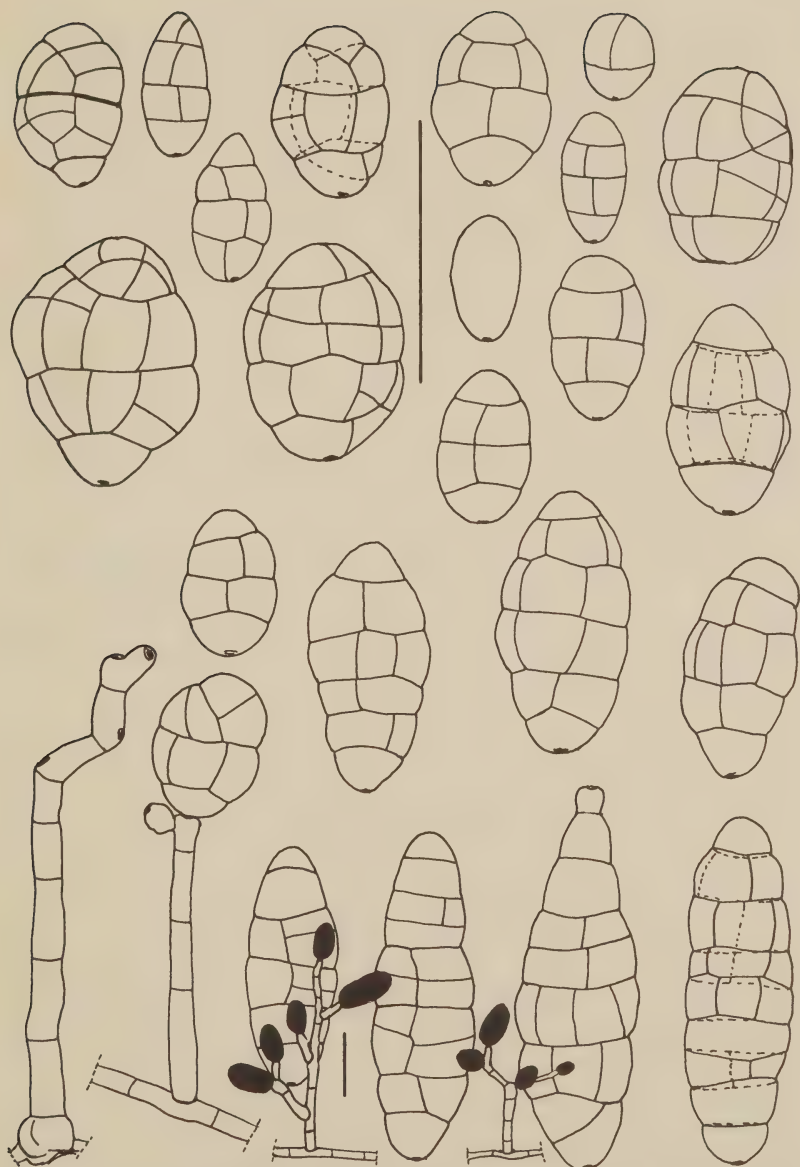


Fig. 103. *Alternaria petroselini*: 6 conidia at upper left ex holotype (CP; EGS 11-062); all others ex representative isolate EGS 06-196. Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

illustration on a different isolate with conidia reaching a maximum of only $57\mu\text{m}$ on rooted parsley. In addition, as is seen in mature cultures of *A. radicina*, the conidium population of Neergaard's isolate of *A. petroselini* (PCA) is dominated overwhelmingly by relatively short-ovoid and short-broad elliptical to subsphaeroid spores. The kind of relatively long-ellipsoid conidia emphasized in Neergaard's illustration and discussion constitutes a prominent portion only of initial sporulation in young cultures (PCA, ca. 5d) of the small-spored isolate; these are lost in the crowd as the strongly dominant mature conidium shape becomes short-broad in cultures at ca. 10-14d.

The information presented by Neergaard for isolates from parsley cultivars suggests a possibility that he was handling two different taxa, a preponderantly small-spored species, as in the type of *A. petroselini*, and a second species with larger conidia (see Alt.T&V 129, *A. selini*, below). Comparison of other available specimens and isolates from parsley supports this suggestion.

I have seen only two other isolates readily identifiable with Neergaard's typical material of *A. petroselini*. One was isolated by J. W. Groves from California-grown parsley seed (DAOM 42-I-356A; EGS 09-159). The second was isolated from rot of a parsley petiole base growing in California (L. Davis no. 135; EGS 12-162).

As indicated above, conidia of the type specimen of *A. petroselini* are broadly ovoid to subsphaeroid, reaching $28-47 \times 16-35\mu\text{m}$ (mature l/w = ca. 1.2-1.4), with 3-4 complete or partial transverse septa, 2-4 longisepta in broadest segments, and 1 longitudinal or oblique septum in either or both of the rounded end segments. Conidia appear smooth and are a medium dull yellow-brown (after years in lactic acid mount). There is no evidence of secondary conidium production in the material examined.

Conidia in young (PCA, 5d) cultures of *A. petroselini* exhibit the full range of size and shape found on PCA; longer growth periods affect only relative quantities of different shapes. About half the young population develops along the ovoid-subsphaeroid path to shapes about the same as those of the type, though somewhat smaller (a size difference commonly characteristic of heavily sporulating cultures of *Alternaria*), $35-38 \times 20-24\mu\text{m}$ (l/w = ca. 1.5); the other half develops in a long-ellipsoid pattern to shapes not found in the type, $50-62(-66) \times 20-26\mu\text{m}$ (l/w = ca. 2.5-3.3).

Conidia in samples from older cultures (PCA, 10-14d) are predominantly ovoid-subsphearoid, with long-ellipsoid spores present in very small numbers. Upper size ranges and l/w ratios of the two spore shapes are essentially the same as those noted for young cultures. Septation of ovoid-subsphearoid conidia has the same pattern as that of the type; long-ellipsoid conidia become 6-9 transeptate with 1-3 longisepta in about half to all but the basal segment. A primary conidium with a 1-celled apical conidiophore is seen very rarely. Most mature conidia appear quite smooth, sometimes punctulate, and a rather dull medium brown, with septa darker and well defined but not thicker than the outer wall.

* * * * *

M. B. Ellis's collegial attribution of the novel name combination *A. petroselini* (Neerg.) Simmons (Alt.T&V 128) was based on my response some 20 years ago to his query of whether or not I considered *A. petroselini* distinguishable from *A. radicina*, which I did then and still do on the basis of Neergaard's type specimen and isolate and other identifiable isolates. Ellis's subsequent (1976) description and illustration of obclavate conidia as long as 105 μ m (av. 88 μ m) represented IMI holdings at that time, especially an isolate from Saudi Arabia, discussed below as ex-type of *A. selini*. The IMI specimens, though representative of the erostrate-conidium species-group of *Alternaria*, are not of *A. petroselini* as defined by Neergaard's conserved materials. They are, at least in part, *A. selini*.

129. *Alternaria selini* Simmons, sp. nov. Fig. 104, 105
(Etyim.: L., *selinum* = parsley)

Conidia erostrata, in maturitate nec ellipsoidea, ovoidea vel obovoidea (ad ca. 42 x 12-20 μ m) et late ovoidea vel valde obclavata (ad ca. 65-80 x 22-26 μ m), 5-13 transverse septata et 1-3 longiseptata, modice luteobrunnea, laevia. Habitatio typi in foliis Petroselinum crispum (Mill.) Nym., Qatif Oasis, Saudi Arabia. Holotypus: IMI 137332, lectus H. Martin, 18 June 1968 (EGS 25-198).

This second taxon on parsley cultivars is represented by a field specimen on leaves of "French parsley," Suffolk, U.K. (IMI 134072; EGS 25-197); the holotype specimen and an isolate derived from it (IMI 137332; EGS 25-198); and an isolate from parsley crown decay, California, U.S.A. (EGS 35-178). If one of Neergaard's isolates was of this taxon, it would explain the maximum dimensions given in his de-

scription for *A. petroselini* (Alt.T&V 128), which are atypical in that they are not found in his holotype or in his extant isolate of the species.

Typical *A. selini*, defined by the original field specimen, has solitary erostrate conidia that develop from ellipsoid juvenile stages either into broadly ellipsoid, ovoid or obovoid spores of moderate size (ca. $42 \times 12\text{-}20\mu\text{m}$) or into much larger ones that are either ovoid with broadly rounded ends or sturdily obclavate (ca. $65\text{-}80 \times 22\text{-}26\mu\text{m}$). Field conidia have 5-10 transverse septa and 1-3 longitudinal or oblique septa in most of the transverse segments. Conidium outer walls and most transverse septa (but usually not longisepta) are slightly thickened and appear darker than face-view walls. Wall color in face view is a medium yellow-tan. Walls appear to be smooth.



Fig. 104. *Alternaria selini*: conidia and conidiophores ex holotype (IMI; EGS 25-198). Bar = $50\mu\text{m}$.

Cultures ex-type (PCA, 5-14d) appear similar to those of other members of the *A. cheiranthi* species-group, especially to *A. petroselini* and *A. radicina*: well-separated, relatively short surface conidiophores with an overlying open aerial network of hyphae bearing numerous short lateral conidiophores.

Conidia from PCA cultures present all the different shapes seen in the field type, except that the relatively large, sturdy, obclavate stage is not found. (Under my routine conditions, largest conidia in V-8 colonies sometimes taper enough distally to be termed obclavate.) Although there are large numbers of short-ovoid conidia in culture populations, the general pattern of development is into the dominant long-ellipsoid form.

Short-ovoid conidia reach ca. $32-42(-50) \times 22-27\mu\text{m}$, with 3-5 transepta and 1-3 longisepta in most of the transverse segments. Fully developed long-ellipsoid conidia are ca. $48-65 \times 15-20\mu\text{m}$, with up to 7 transepta and 1-2 longisepta in most transverse segments. Conidium color is a dark but not opaque brown (darker than in *A. petroselini*), with somewhat thickened and darker transverse septa, as in the field type. Walls are smooth or sometimes have minute, scattered punctulation near the conidium base. Secondary conidiophores sometimes are produced but are uncommon.

It is emphasized that I believe that M. B. Ellis's Fig. 325 (1976, p. 418) of "*Alternaria petroselini*" appears to be and, judging from IMI specimen and culture resources, almost certainly is based on the specimen cited here as holotype of *A. selini*. Conidia in the upper two rows of the Ellis illustration are quite typical of ones present in my slide mount from the Saudi Arabia specimen; conidia and conidiophores in the bottom row of the illustration duplicate ones commonly seen in cultures of the ex-type isolate. The maximum length and width dimensions of conidia given by Ellis (105 and $34\mu\text{m}$) are not found in the single slide preparation I have studied. Otherwise, the Ellis description (l.c.) fits *A. selini* very well.

The shape and size of almost any individual conidium produced in cultures of *A. selini* can be found duplicated in culture populations of *A. petroselini*. It would be difficult to differentiate the taxa on the basis of unqualified listings of conidium shape and size ranges. However, original specimens and representative isolates yield sufficient numbers of differences for maintaining them as distinct taxa.

Conidium populations of *A. petroselini* are dominated by short-ovoid to subsphaerical spores; long-ellipsoid spores, though produced, never represent more than a minute percentage of the population in maturing cultures. Just the opposite holds true for *A. selini*, with long-ellipsoid, ovoid, or obclavate conidia always dominant in a population that matures with a low percentage of short-ovoid to subsphaeroid spores.

Conidia of *A. selini* from cultures are darker and have darker and thicker septa than do those of *A. petroselini*. Production of secondary conidiophores and therefore short chains of conidia is not uncommon in *A. selini*. Conidia in field material of *A. selini* are long-ovoid to obclavate at greatest development; conidia of holotype *A. petroselini* are short-ovoid to subsphaeroid.

130. *Alternaria japonica* Yoshii (1941), Byōchūgai-zasshi [Journal of Plant Protection] 28: 17. Fig. 106

= *Alternaria raphani* Groves & Skolko, Can. J. Res., C, 22: 227. 1944.

= *Alternaria matthiolae* Neergaard, Danish Species of *Alternaria* and *Stemphylium*, p.184. 1945.

Difficulty of communication among mycologists in the early 1940's resulted in publication of three different names for an *Alternaria* taxon noted primarily on cabbage and pak-choi (*Brassica oleracea* L., *B. chinensis* L.), radish (*Raphanus sativus* L.), and stock (*Matthiola incana* (L.) R. Br.). Such convergence of attention in countries (Japan, Canada, Denmark) on three different continents is remarkable and remains, within the context of related literature preceding 1941-1945, one of those little mysteries of phytopathology.

The species did not spring into the mycological picture, unique and suddenly pathogenic, in the 1930-40's. Instead, for example, material as old as Roumeguère's (1893) *Fungi selecti exsiccati* no. 6301 (NY; EGS 02-099) contains excellent sporulation of *A. japonica*. The specimen (labeled *A. brassicae* var. *macrospora*) is on *Brassica oleracea* L. var. *acephala* DC., collected in March 1893.

The fact that *A. japonica* occurs on several species and varieties of *Brassica*, coupled with the Saccardo 1880-1886 muddling of the classification and nomenclature of *Alternaria* taxa on brassicaceous hosts (see Section XIX on *Alternaria brassicae*, following), doubtless obscured the distinctiveness of *A. japonica* from *A. brassicicola* and *A.*

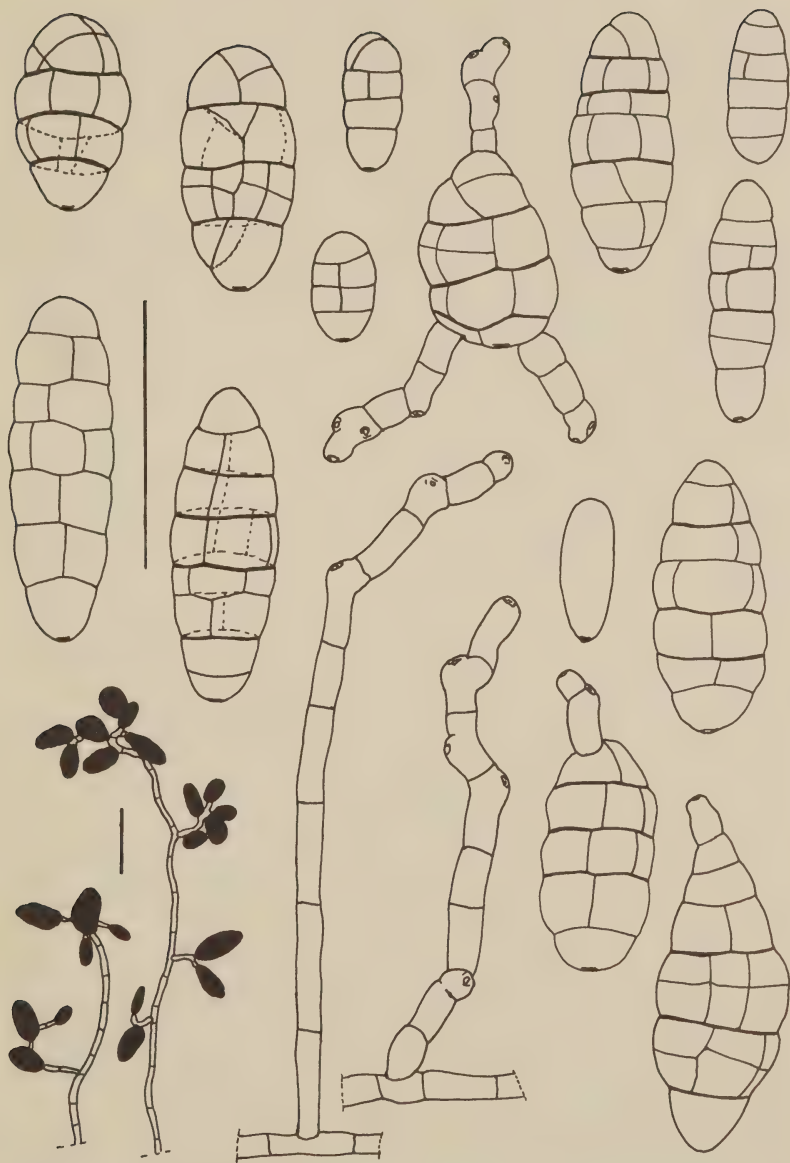


Fig. 105. *Alternaria selini*: conidia and conidiophores ex representative isolate EGS 35-178 (9d PCA). Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

brassicae (Alt.T&V 132 and 135). Wiltshire's observation (1947) that *A. japonica* (as "*A. raphani*") conidia lack the long antennaeform beak characteristic of *A. brassicae* is a helpful field-specimen character. The abundant production of chains and clumps of dark, thick-walled cells in the vegetative mycelium of *A. japonica* cultures also is a helpful clue to determination.

My own experience with *A. japonica* on leafspots of *Brassica* species is highlighted by a single tour through a colleague's Conway, Massachusetts, home garden in October 1967. The mycological harvest was excellent specimens and subsequent isolates from Chinese cabbage, broccoli, head cabbage, and rutabaga (respectively, *B. pekinensis* (Lour.) Rupr., *B. oleracea* L. var. *botrytis* L. and var. *capitata* L., and *B. napus* L. var. *napobrassica* (L.) Rchb.; EGS 21-039, 21-040, 21-042, 21-041).

None of the few dozen binomials published for brassicacicolous alternarioid taxa before 1941 is based on a specimen of this fungus. *Alternaria japonica* Yoshii (1941) is the earliest legitimate and, therefore, correct name of the taxon.

Tohyama and Tsuda (1990), attempting to establish the identity and typification of the species, selected as lectotype one of the three dried-down plate cultures (159, 159a, 159b) conserved in IMI 876 (EGS 42-024); all three discs were derived from an isolate Yoshii 49, probably received by Wiltshire at IMI in 1933. The "lectotype" selection is readily identifiable as preparation 159b through comparison with Tohyama and Tsuda's Fig. 6 (l.c.). The three dry agar discs are accompanied by two slide preparations: no. 153 from a culture "on cmm" (presumably = clear maize meal agar) "13/12 - 21/12/33" and no. 156 from a culture on "malt" grown "18/12 - 15/1/36."

Notations on the two IMI 876 slide labels show that Wiltshire studied Yoshii's isolate in subcultures in 1933 and again in 1936. The three agar discs conserved at IMI are believed to represent Wiltshire's subcultures, not Yoshii's original culture sample. All three of the dry preparations have abundant chlamydospores typical of *A. japonica* radiating from small bits of inoculum. However, I have been unable to locate conidia of *A. japonica* on any of the dry discs, either by direct examination at 50X or among samples of hyphae and chlamydospores examined at higher powers. (Dark, thick-walled conidia of *A. japonica*, if present on the discs, should be easily visible on the discs

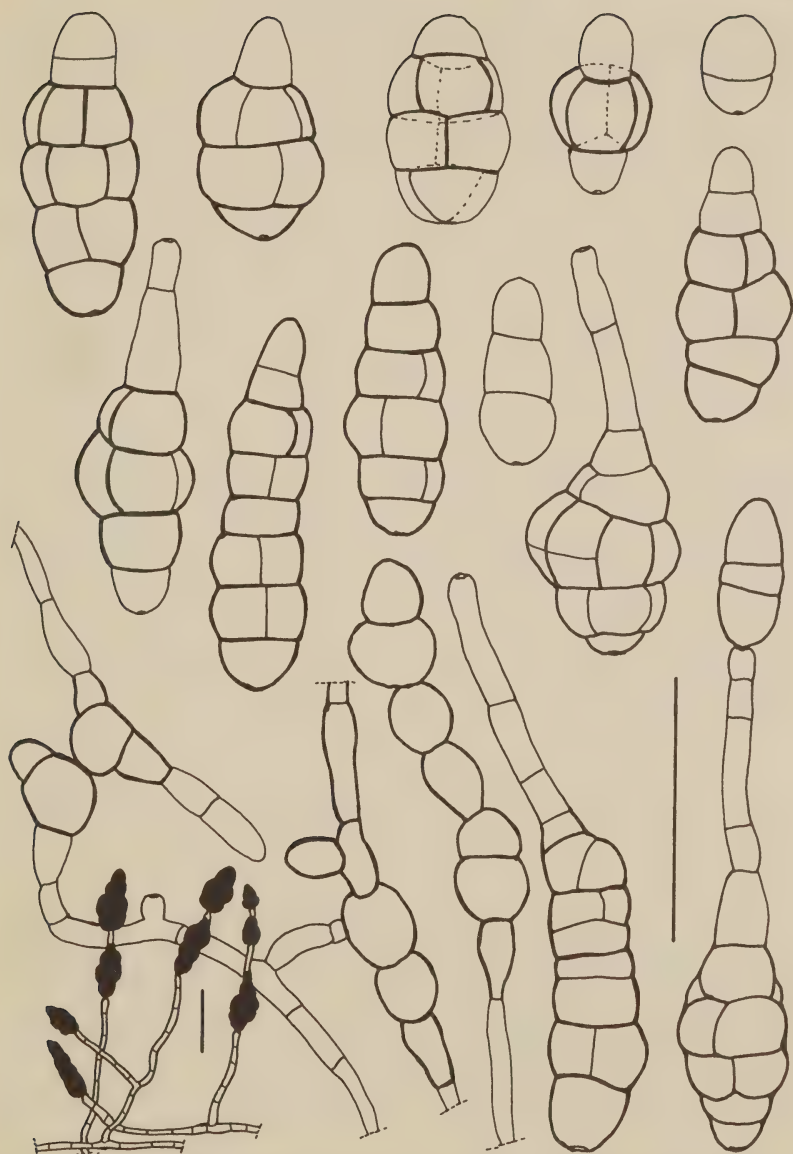


Fig. 106. *Alternaria japonica*: conidia, conidiophores, and hyphal chlamydospores ex representative isolate EGS 41-158 (10d PCA). Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

at 50X, for a few identifiable spores of *A. brassicicola*, noted by Wiltshire as a contaminant, are visible at that magnification on the agar surface.)

IMI slide 153, dating from 1933, bears a note "Sterile but showing chlamydospores." It is a mount of a triangle of agar from dried culture 159.

Of all the material conserved as IMI 876, only slide 156, dating from 1936, bears conidia of *A. japonica*, as nearly as I can determine. This permanent preparation, in excellent condition, is labeled "*Alternaria brassicae* var *macrospora* sensu Yoshii. [i.e., Yoshii's concept in 1933 of what he published as *A. japonica* in 1941] -- Yoshii's Dried culture 159a revived and transferred to P.D. 229c2 - malt. 18/12 - 15/1/36. slide 156."

This slide 156 of IMI 876 is selected here as neotype of *Alternaria japonica* Yoshii (1941), as Yoshii's original collections on *Brassica* species and *Raphanus sativus* are believed lost. Recorded provenance of the fungus material on the neotype slide is from Yoshii to Wiltshire in 1933, with related support of Yoshii's illustrations (1933), part of which he reproduced in his 1941 publication along with his formal description of *A. japonica*. The Tohyama and Tsuda 1990 "lectotypification" is inappropriate in that no original material specified in the *A. japonica* protologue is known to exist.

Conidia of *A. japonica*, like those of other members of the *A. cheiranthi* species-group, are essentially beakless. Field specimens give evidence of production of short chains of probably 2, at most 3 spores in addition to the mostly solitary conidia.

Field conidia are broadly ellipsoid or ovoid to obclavate, with a bluntly rounded apical cell that may develop through an abrupt transition into a broad, short 1-2-celled secondary conidiophore. Largest field conidia reach a range of ca. 80-100 x 20-30 μ m, initially are smooth but may become evenly pitted or punctate-rough at maturity, are a medium translucent tawny brown in color, and have 7-10 transverse septa and 1-3 longisepta in several of the transverse segments.

Sporulation in PCA plate cultures, though abundant, is relatively open in contrast to the dense thickets of conidiophores and conidial chains of, for example, *A. alternata*. Primary conidiophores arise directly from the

alternata. Primary conidiophores arise directly from the agar surface or, to a great extent, from fertile aerial hyphae that form a loose, almost cobwebby network similar to that observed in cultures of other taxa of the *A. cheiranthi* species-group. As with field sporulation, conidia in cultures may remain solitary or to a major degree form chains of 2-4 spores. Secondary conidiophores in such chains of non-beaked conidia may be simply a perforation in an otherwise unchanged apical cell, or they may be well-differentiated outgrowths up to ca. 55-60 x 5-6 μm .

Conidia produced in culture are basically short to long ovoid, beakless, and with a good degree of lateral symmetry when young. Maturing conidia almost always are strongly constricted at most of their transverse septa and typically retain lateral symmetry or, in some isolates, have several cells that are variously swollen. Conidia are smooth and medium tawny or cinnamon brown in color when young and may remain so or only slightly darker throughout development to maximum size. In some isolates apical and basal cells of conidia remain the original medium orange-brown while all other cells become much darker brown, frequently nearly opaque, and at times evenly pitted or rough.

A constant feature of all known isolates of *A. japonica* is production of distinctive chains or knots of dark, thick-walled, often strongly ornamented cells in surface and subsurface hyphae. Such chlamydospores may be sparse and radial in developing hyphae or, in some isolates, so dense that the substrate appears almost opaque.

A high percentage of the spore population matures in culture as broadly ovoid conidia with only 2-3 transverse septa plus 1-2 longisepta in 1-3 of the transverse segments; size range is ca. 35-45 x 20-24 μm . Another high percentage of spores matures with 5-7 transverse septa and 1-2 longisepta in a few to most of the transverse segments; size range (spore body only) is ca. 55-70 x 18-22 μm .

131. *Alternaria smyrnii* (Crouan) Simmons (1995), Mycotaxon 55: 41. Fig. 107, 108

- = *Helminthosporium smyrnii* Crouan, in P. L. Crouan and H. M. Crouan, Florule du Finistère, p. 11. 1867.
- = *Macrosporium smyrnii* (Crouan) Saccardo, Syll. Fung. 4: 527. 1886.
- = *Stemphylium ramulosum* Saccardo, Michelia 1: 360. 1878.

- = *Macrosporium ramulosum* (Sacc.) Sacc., *Fungi italici* autogr. del. no. 854. 1881.
- = *Alternaria ramulosa* (Sacc.) Joly, *Encycl. Mycol.* 33: 213. 1964.

The Crouan (1867) species apparently requires neotypification, in that the only pertinent specimen found in their herbarium at Concarneau (with manuscript description and good drawings) is noted as "*sur les tiges mortes du Smyrnium olusatrum*. hiv. *Print. p.c.* (vv)," whereas the published description reads "*sur les tiges mortes de Smyrnium olusatrum, sous le château de Brest. Aut. p.c.*" If the abbreviations can be shown to refer to the same specimen (I believe not), then neotypification would become superfluous. In the absence of known additional specimens, the single extant specimen noted above is chosen as neotype of the original name and taxon (CO; EGS 30-028).

The history of genus name changes for this taxon, morphologically striking both in nature and in culture, attests to the difficulty hyphomycetologists have had in defining and circumscribing members of the erostrate-conidium species-group of *Alternaria*, to which *A. smyrnii* belongs. The label of the Crouan neotype actually reads "*Septosporium smyrnii*" (never published in this form), along with a manuscript description that is essentially the same as the published type description of *Helminthosporium smyrnii*. Saccardo's material of the same taxon (PAD; EGS 11-195) was assigned first to *Stemphylium*, then to *Macrosporium*, and finally (correctly) to *Alternaria*, as indicated in the synonymy above.

The fungus occurs in effuse black patches on old stalks of alexanders (*Smyrnium olus-atrum* L.), an apiaceous herb formerly used like celery. Both the type and excellent modern living material (EGS 37-093, sent by M. B. Ellis in 1984) are on this host. The species also occurs in abundance on old stalks of cow-parsley (*Anthiscus sylvestris* (L.) Hoffm.) (IMI 1276; EGS 22-012) and on parsley (*Petroselinum crispum*) in Saccardo's type of *Stemphylium ramulosum* (PAD; EGS 11-195).

Extensive black field colonies of *A. smyrnii* are (at 50X) composed of open to dense thickets of erect, rigid, shiny black, setose conidiophores. At higher magnifications, these conidiophores are seen to be very dark brown, thick-walled, and closely septate, arising singly or more often in clumps from enlarged, rough, cellular bases or from multicellular sclerotia. They range from 200-300 μ m

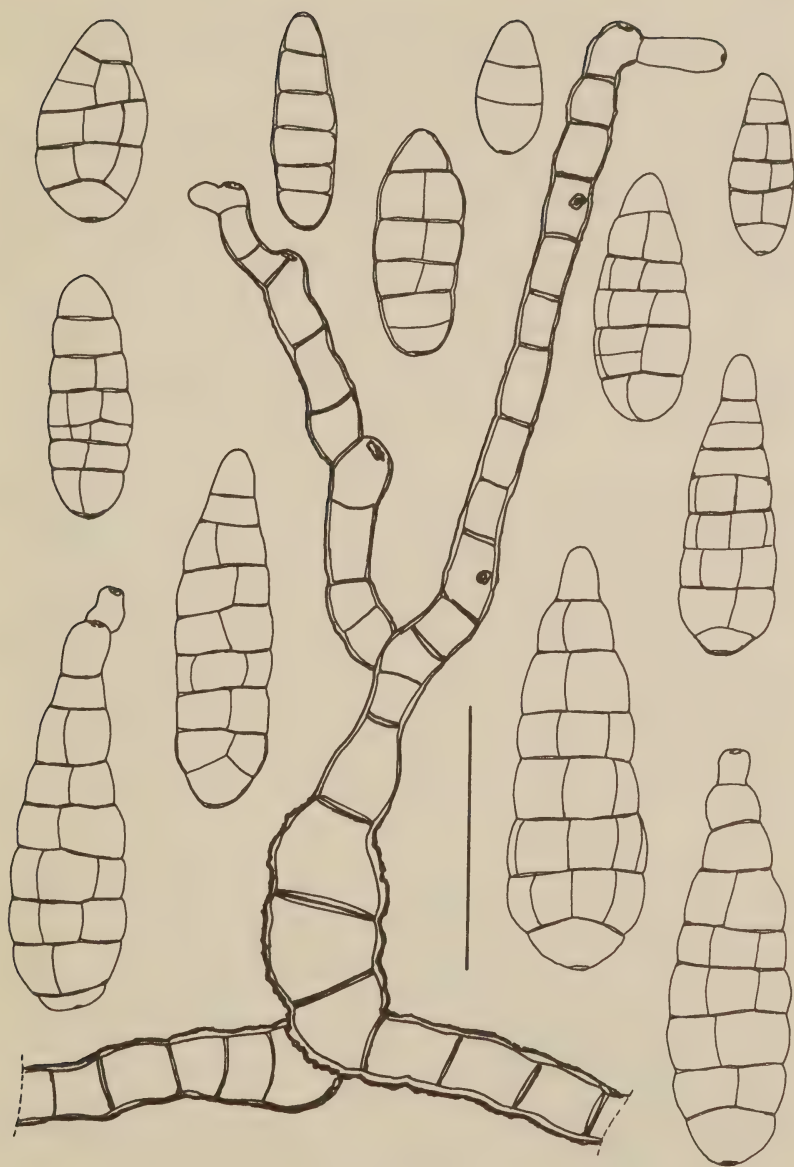


Fig. 107. *Alternaria smyrnii*: conidia and conidiophores ex neotype (CO; EGS 30-028). Bar = 50 μ m.

to well over 500 μ m long x ca. 11-25 μ m wide; they often are conidiogenous at well-separated geniculate sites or from several short, closely consecutive apical cells.

Conidia in the field type are ovoid, with 7-8 slightly constricting, well-defined but not thickened transepta and 1-3 longisepta in a few to most of the transverse segments, up to ca. 64-96 x 24-27 μ m, pale to medium yellowish brown, and smooth. Occasional short, 1-celled apical secondary conidiophores are evidence that chains, probably very short, are produced.

An excellent isolate of the species from "animal feeding stuff," U.K., has been available for many years (IMI 115988; EGS 27-177); and an even better one was isolated from a 1984 M. B. Ellis specimen (EGS 37-093) on *Smyrnia*.

The appearance of *A. smyrnii* cultures (PCA 5-10d) is similar to that of other members of the *A. cheiranthi* species-group. Short to long erect conidiophores originate at or beneath the agar surface, sometimes as distinguishable individuals in a close turf of sporulating structures and often as clumps arising from conspicuous knots or sclerotial growths of very dark cells formed within or on the agar substrate. Free-standing conidiophores are ca. 100-600 (or often much more) x 3-7 μ m, dilute yellow-tan, with conidiogenous branches at various levels. The longest conidiophores arch and entangle, forming a loose pseudo-network above the colony. Conidiophores that originate in sclerotial knots do not develop through to spore production within ca. 2 weeks of active culture, but eventually do so.

Conidia produced in culture are ovoid (as in field specimens), sometimes obovoid, or to a high percentage narrowly ovoid or ellipsoid, with 7-8 transverse septa in largest ovoid spores, up to 10 transepta in narrowly ellipsoid spores, and 1-2 longisepta in a few of the transverse segments. Ovoid and obovoid conidia reach a size range of ca. 40-58 x 18-22 μ m and the narrower ellipsoid ones, which dominate the population, ca. 67-96 x 13-16 μ m. Conidia are smooth, occasionally punctulate, and medium brown in color. Chains of 2 conidia occur commonly, with the generating secondary conidiophore usually a single short cell or sometimes nothing more than a slight apical, aseptate swelling with an apical conidiogenous site.

The nine taxa of the *A. cheiranthi* group recognized at present are keyed below on selected characters.

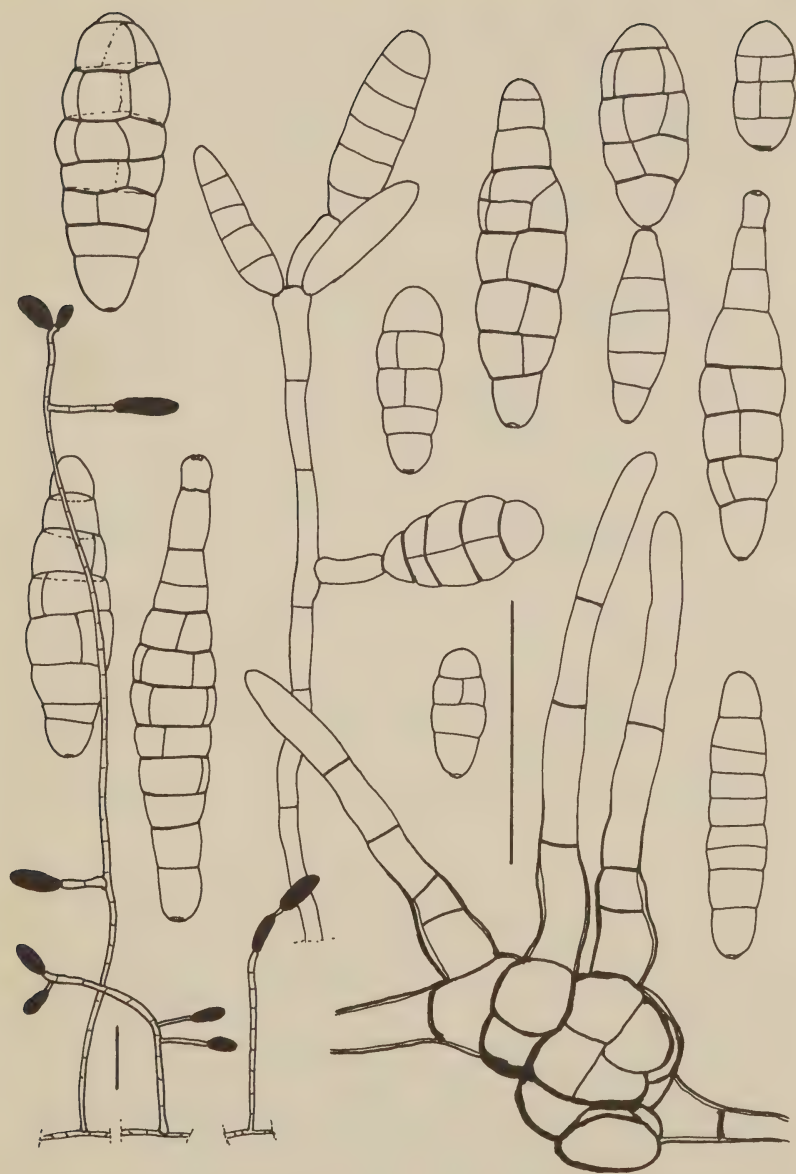


Fig. 108. *Alternaria smyrnii*: conidia, conidiophores, and cellular knots with developing megaconidiophores ex representative isolate EGS 37-093 (9d PCA). Bar = 50 μ m.

Key to *Alternaria cheiranthi* species-group
(from PCA cultures when available)

- A. Conidial chains dominant/common B/b
- a. Conidial chains absent/rare/uncommon. E/e
- B. Enlarged hyphal cells (chains/knots) prominent. C/c
- b. Enlarged hyphal cells not found D/d
- C. Conidium max. ca. 55-70 μ m long; chains of
hyphal chlamydospores characteristic. . 130 *japonica*
- c. Conidium max. ca. 67-96 μ m long; cellular
knots bear megaconidiophores. 131 *smyrnii*
- D. Secondary conidiophores long, con-
spicuous; chains of 2-6 conidia . 123 *cheiranthi*
- d. Secondary conidiophores very short;
chains of 2-3 conidia 127 *carotiincultae*
- E. Conidium max. length range ca. 90-100 μ m;
(no cultures) 126 *atrocariis*
- e. Conidium max. length range ca. 45-65 μ m. F/f
- F. Conidium dominant length ca. 48-65 μ m. . 129 *selini*
- f. Conidium dominant length ca. 35-50 μ m. . . . G/g/g
- G. Conidia predominantly ovoid/subsphaeroid
at 10-14d; up to 35-38 μ m long 128 *petroselini*
- g. Conidia predominantly ovoid/obovoid;
up to ca. 42-50 μ m long. 125 *radicina*
- g. Conidia ovoid; 33-45 μ m (no cultures). . 124 *instipitata*

XVIII. THE *ALTERNARIA BRASSICICOLA* SPECIES-GROUP

Alternaria brassicicola (Schweinitz) Wiltshire (1947) exhibits sufficiently distinctive characters that it rarely would be misidentified with other small-spore, long-chain species when examined microscopically from culture. Conidial chains proliferate rapidly, sometimes with as many as 20+ conidia in linear progression with only minor 1-2-conidium side branches. More characteristically, however, the sporulation apparatus (viewed at 50X) has much the same habit on PCA and V-8 as does *A. alternata*, i.e., the pattern is of a short to moderate length, solitary, erect conidiophore supporting long, freely branching chains in an open, bushy growth of 50-60+ conidia.

The most striking characters of the conidia are the deep rich chestnut brown color of the conidium wall and septa (as seen in edge view), the predominantly short cylindrical or truncate-conoid, 1-celled secondary conidiophores (lighter in color than the otherwise beakless spore body and sometimes induced to sporulate so quickly that a basal septum is not formed), the consistently moderate amount of constriction at dark septa, and the absence of longitudinal septa in an extremely high percentage of the conidium population.

As to similar species, Neergaard recognized (1942a) and described (1945) *Alternaria resedae* Neerg. on and isolated from *Reseda odorata* L. He considered and illustrated it as being similar to *A. brassicicola* but separable from it in some details of morphology and pathogenicity. (See discussion of *A. resedae* in *Alt.T&V* no. 133 below.)

A third name, *Sporidesmium septorioides* Westendorp (1854), also is typified by an *Alternaria* on *Reseda*. The conidia in the type specimen cannot be distinguished from those in young field specimens of *A. brassicicola*.

Examination of a few dozen isolates referable to the *A. brassicicola* species-group has yielded only a few that are not readily recognizable as typical of the species. One of these mimics *A. brassicicola* in essentially all characters except conidium size and septation; it is discussed below as a new species (*Alt.T&V* no. 134).

132. *Alternaria brassicicola* (Schweinitz) Wiltshire (1947)
Mycol. Pap. 20, p. 8. Fig. 109, 110

- ≡ *Helminthosporium brassicicola* Schw. ('*brassicola*'),
Trans. Amer. Philos. Soc., 4: 279. 1832.
- = *Sporidesmium septorioides* Westendorp, Bull. Acad.
R. Sci. Belgique 21: 236, f. 4 (opp. p. 246). 1854.
- = *Sporidesmium exitiosum* Kühn f. *alternarioides* and
f. *luxuriosum* Kühn, Hedwigia 1:91, Taf. XII-B, fig.
1-22. 1855.
- = *Polydesmus exitiosus* (Kühn) Rabenh. f. *alternario-*
ides and f. *luxuriosum* Kühn, Die Krankheiten der
Kulturgewächse, p.165. 1858.
- ~ *Macrosporium circinans* Berk. & Curt., nomen nudum,
in M. A. Curtis, Geol. & Nat. Hist. Surv. North
Carolina, Pt. III, Botany, p. 128. 1867.
- ~ *Macrosporium cheiranthi* (Lib.) Fr. var. *circinans*
(Berk. & Curt.) Berk., nom. comb. illegit., Gre-
villea 3: 105. 1875.

- ~ *Macrosporium commune* Rabenh. (1870, nomen nudum) var. *circinans* (Berk. & Curt.) Sacc., nomen comb. illegit., Syll. Fung. 4:524. 1886.]
- ~ *Alternaria circinans* (Berk. & Curt.) Bolle, nomen comb. illegit. (1924), Meded. Phytopath. Lab. Willie Commelin Scholten 7: 26. 1924.]
- = *Alternaria brassicae* (Berk.) Sacc. var. *minor* Sacc., *Michelia* 2: 172. 1880c.
- ~ *Alternaria brassicae* (Berk.) Sacc. f. *microspora* Brunaud, Actes Soc. Linn. Bordeaux 52: 149. 1897. [Type description only suggestive; type specimen not known.]
- = *Helminthosporium brassicae* Hennings, *Hedwigia* 41: 117. 1902.
- = *Alternaria oleracea* Milbrath, Bot. Gaz. 74: 320. 1922.

The type collection of *A. brassicicola* is on irregular lesions of *Brassica* leaves. Schweinitz's description of the taxon is far from being definitive, but subsequent study of portions of the type by Wiltshire (1947) has established that "*Helminthosporium brassicola* Schweinitz" is the earliest published name and description for a commonly encountered pathogen of many brassicaceous plants.

Wiltshire's characterization and illustrations of the taxon are excellent guidance, as are those of Neergaard (1945) and of M. B. Ellis (1971), whose technique of stippled shading projects a correct impression of strongly pigmented spore walls and septa.

Lesions caused by *A. brassicicola* are of major occurrence on unprotected, naturally infected brassicaceous crops. The species is so commonly present on seed crops of *Brassica* spp. that it often can be isolated from packeted seed obtained in garden supply stores, as was an excellent representative EGS 42-002, used as a basis for the accompanying description and illustration (from commercial seed of *Brassica oleracea* L., U.S.A. source, Feb. 1994).

Stable isolates produce intensely brown-black, spreading colonies on PCA and V-8 agars (colonies on Hay restricted, ca. 5mm diam. in 2-3 wks). Sporulation in stable isolates is almost entirely from abundant, closely adjacent primary conidiophores that arise directly from the agar surface. Conidiophores are simple, with a single apical conidiogenous site, or variously branched and geniculate with conidiogenous sites at the tip of each branch or bend; color dilute tan, size ca. 15-65 x 5-6µm.



Fig. 109. *Alternaria brassicicola*: 6 conidia, upper left, ex lectotype (PH; EGS 05-167); all others and conidiophores ex representative field specimen EGS 42-002. Bar = 50 μ m.

Conidia are borne in long chains, usually with the initial few spores strikingly larger than subsequent secondary spores, which tend to be progressively smaller as the chain lengthens. Young unbranched chains may have 10-20 spore units. Usually, however, multiple branching of primary conidiophores and chains is a dominant character, resulting in loose tufts of 50-60 or more conidia.

Conidia in individual sporulation tufts (on PCA) are narrowly ovoid or ellipsoid in the larger initial units, then progressively broader ovoid, then smaller ovoid in terminal regions of the chain. Initial conidia have a size range of ca. $50-60 \times 12-17\mu\text{m}$ and 6-7 transepta with 0-1 longiseptum in a few segments; intermediate ovoid spores ca. $30-40 \times 15-18\mu\text{m}$ and 4-5 transepta with 0-2 longisepta in a few segments; smaller ovoid spores ca. $10-25 \times 6-10\mu\text{m}$ and 1-3 transepta with no longisepta.

No individual conidium has a true beak. The terminal conidium in any chain has a rounded apex. All other conidia, in both nature and culture, have an apical conidiogenous structure which usually is a 1-cell secondary conidiophore ca. $5 \times 5\mu\text{m}$, but which also frequently is a smaller, similar outgrowth lacking a septum to separate it from the spore body. (Secondary conidiophore measurements are not included in conidium dimensions given above.)

The spore body of conidia of all sizes (except of the youngest) is a medium yellowish to reddish brown in face view; the apical secondary conidiophore is a dilution of the same color. The spore wall, in edge rather than face view, and septa are of a similar but darker brown. Septa appear somewhat thickened in edge view, but are not typically embellisioid. Practically every transverse septum imposes a moderate degree of constriction on adjoining spore walls. The spore wall itself usually is quite smooth, but sometimes has punctulate or, in age, even more pronounced ornamentation.

Conidium color of typical isolates always darkens into medium to dark brown hues, which are particularly evident in walls and septa in edge view. Conidia of at least one isolate consistently remain yellowish-tan but otherwise have typical morphology (EGS 36-158; reed 1983 as an allergen, natural source unknown; Spokane, Washington). Isolates totally devoid of pigment but otherwise typical also are known, e.g., EGS 30-177B, from a natural sector in an isolate from *Brassica oleracea*, Jogjakarta, Indonesia, March 1969.

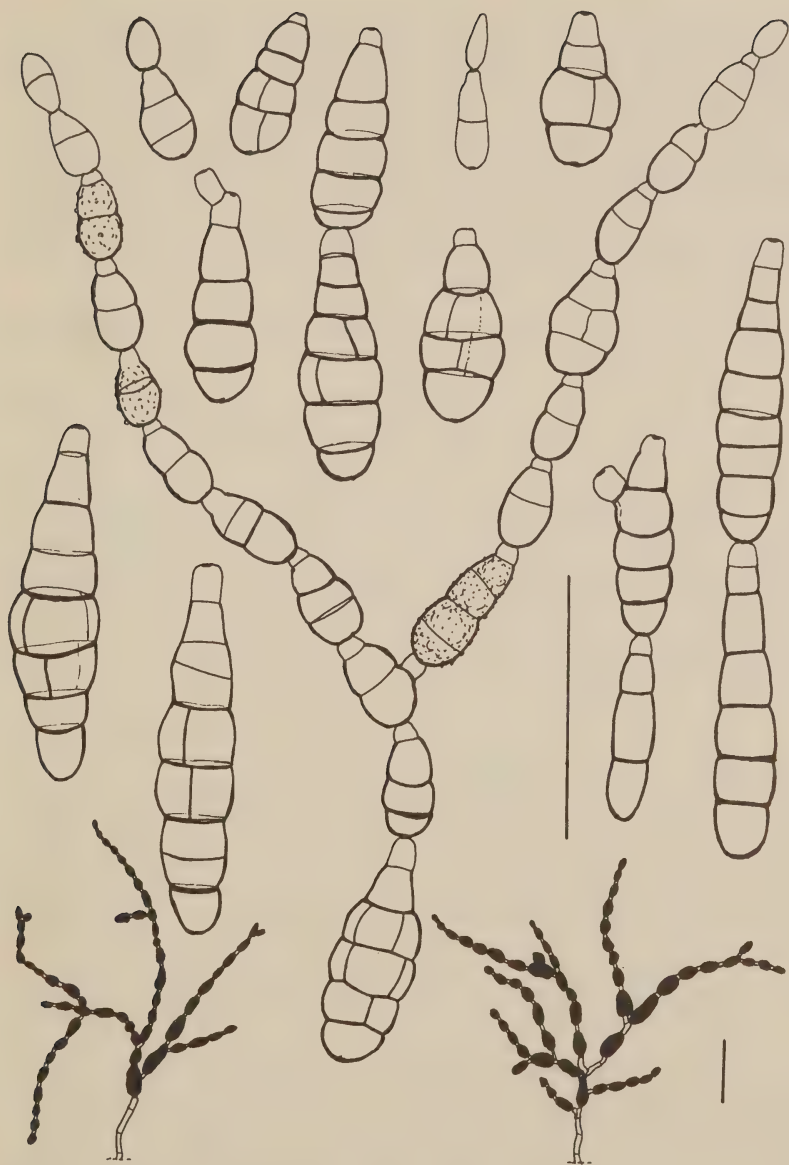


Fig. 110. *Alternaria brassicicola*: conidia ex representative isolate EGS 42-002 (7d PCA). Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

Alternaria brassicicola occurs conspicuously and worldwide on brassicaceous hosts, but there also are reports that the species may occur in nature on other plants. The relationship, as parasite or as casual inhabitant, is not known in these latter instances. Groves and Skolko (1944) reported isolation from *Phaseolus coccineus* L.; Neergaard (1945) from *Artemisia* sp. and *Thymus vulgaris* L.; and Joly (1964) from seeds of several plants, including species of *Linum*, *Papaver*, *Phaseolus*, and *Scorzonera*. These reports require verification, which I have not done because, in general, voucher specimens are lacking.

133. *Alternaria resedae* Neergaard (1945), Danish Species of *Alternaria* and *Stemphylium*, p. 150.

~ *Alternaria resedae* Neergaard, nomen nudum, Aarsb.-retn. J. E. Ohlsens Enkes Plantepat. Lab. 7: 9. 1942a.

Neergaard's differentiation criteria, as applied to his illustrations (1945), may support his concept of a second species morphologically similar to but distinguishable from *A. brassicicola*. He mentioned differences in spore color, longitudinal symmetry, and apical taper, with *A. resedae* conidia paler and more asymmetrical than those of *A. brassicicola*, and gradually tapering into a 1-2-celled cylindrical secondary conidiophore.

The portions of the purported *A. resedae* type specimen and ex-type culture that I have seen have little morphological resemblance to the type description. Some of Neergaard's "type specimens," deposited at the Veterinary and Agricultural University, Copenhagen (CP), are filter paper disks bearing several seeds that had been held under incubator conditions; fungus growths from different seeds on the same disk sometimes are macroscopically different.

The type preparation of *A. resedae* is ca. 20 seeds of *Reseda odorata* on filter paper (CP; EGS 11-063). Some *Alternaria* conidia were found in dark growth near some seeds, but they are not a good match for the type description. An isolate shared with me in 1954 as CBS 115.44 *Alternaria resedae* (EGS 07-030) arrived with the CBS information "single spore isolation from seeds of *Reseda odorata*, 8-10-41; 1944 sent by Neergaard; no spores at time of arrival." Manipulation of substrate and light conditions induced production of a few conidia, but neither the growth nor the spores are near enough Neergaard's description to be reliable as a type foundation.

Neergaard was very familiar with the characteristics and pathology of *A. brassicicola* (which he called *A. circinans*). He considered the conidia of *A. resedae* and *A. brassicicola* to have "a rather strong resemblance," an opinion that is supported by his illustrations. Although he qualified the resemblance by listing several differential characters, it remains necessary that any identifiable collection or isolate of *A. resedae* must look very much like *A. brassicicola*. The conidia that I have seen from the "type" specimen and from an ex-type culture are not convincingly useful for characterizing the taxon.

134. *Alternaria mimicula* Simmons, sp. nov. Fig. 111
 Etym.: *L. mimica* + -ula, somewhat imitative (of *A. brassicicola*)

Ex culturis in agar PCA descripta. Alternariae brassicicolae similis, sed conidiis minoribus. Conidiophora distincta, erecta, ad 4-5 locos conidiogenos. Conidia catenata, 30-40+ in quoque conidiophoro; prima longioidea vel ellipsoidea, 35-40 x 7-10µm, transeptis 3-6, longiseptis nullis, cetera brevioidea, 8-18 x 5-8µm, transeptis 1-2, longiseptis nullis; rostro ca. 3-4 x 2-3µm; translucide flavobrunnea, septis atrobrunneis; plerumque laevia. Habitatio typi in plantulis Lycopersicon esculentum, ante 1950, Georgia, U.S.A. Typus: partes ex cultura EGS 01-056 desiccatae et in BPI (holotypus) et saltem in IMI (isotypus) conservandae.

An isolate used for many years in fungicide testing at the Boyce Thompson Institute (when at Yonkers, New York) has been maintained by me (EGS 01-056) and others (e.g., QM 280, ATCC 12251) as *A. brassicicola*, simply because it resembled that taxon in most characters except conidium size range (isol. from tomato transplants, Georgia, U.S.A., before 1950). The isolate has remained culturally stable with abundant sporulation for at least 45 years. In current restudy, it is consistently and readily distinguishable from *A. brassicicola* in sporulation habit (at 50X) and in microscopic details (at 195X and 780X).

Colony growth on PCA, Hay and V-8 agars is much the same as that of *A. brassicicola*, with a spreading rate ca. 2cm diam./wk on PCA and V-8 but very restricted colonies on Hay (ca. 5mm/2 wks). Abundant but uncrowded conidiophores arise directly from the agar surface. There are almost no aerial hyphae. Conidiophores are branched and geniculate, with branching chains of 8-10+ conidia at each sporogenous site. The main conidiophore axis is ca. 75-150 x 6µm.

Sporulation heads of *A. mimicula* usually have only 4-5 divergent chains (totalling ca. 30-40 conidia), and thus present a 50X picture much more open than is seen in the dense, crowded sporulation masses of *A. brassicicola*.

The initial 1-2 conidia in any chain commonly are long ovoid or ellipsoid and about twice as long as ca. 90% of conidia in the population of secondary spores. Longest conidia are ca. $35-40 \times 7-10\mu\text{m}$, with 3-6 transverse septa and no longisepta. Most other conidia are short ovoid, ca. $8-18 \times 5-8\mu\text{m}$, with 1-2 transepta and no longisepta. Conidia with a longitudinal septum are extremely rare; they are ca. $20-25 \times 5-8\mu\text{m}$, with 3-4 transepta and a single longiseptum in the broadest median transverse segment.

All conidia except the youngest in a chain produce a single apical secondary conidiophore ca. $3-4\mu\text{m}$ wide $\times$ $2-3\mu\text{m}$

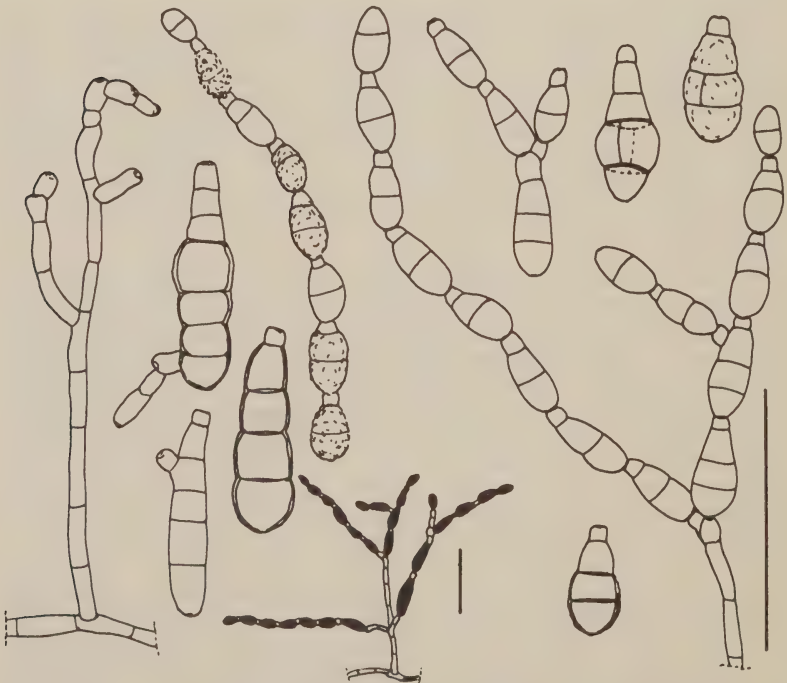


Fig. 111. *Alternaria mimicula*: conidia and conidiophores from ex-holotype isolate EGS 01-056 (7d PCA). Habit: conidia (opaque) and conidiophores (clear). Bars = $50\mu\text{m}$.

long; infrequently this apical structure is 2-celled and ca. 10 μ m long. The secondary conidiophore may be 1-geniculate, initiating branches in the conidial chain. Secondary conidiophores also occasionally develop laterally from any cell of a conidium, with subsequent chain branching, but usually not more than one such lateral conidiophore is produced per conidium.

Conidium color is similar to that of *A. brassicicola* but less intense, viz., medium yellowish tan with darker septa in edge view; outer walls are usually smooth, but sometimes are detectably rough (pusticulate) and occasionally definitely tuberculate.

XIX. *ALTERNARIA BRASSICAE*, "THE CABBAGE MACROSPORIUM,"
21 OF ITS SYNONYMS, PLUS SELECTED MISDETERMINATIONS

The abundance of names that can be established as synonyms of *Macrosporium brassicae* Berk. (1836) reached its maximum, we can hope, when Wiltshire (1947) surveyed the 30+ names and available type specimens associated with *Alternaria* species reported to occur on brassicaceous hosts. No Berkeley specimen of the taxon is known to exist. (For formal neotypification see *Alt. Chronology* 1836.) The original description (l.c., p. 339) reads: "*M.[acrosporium. Fr.] Brassicae*, Berk. (cabbage *Macrosporium*); flocci obsolete, sporidia clavate antennaeform 5-11-septate rather longer than the peduncle. On decaying cabbage leaves amongst *Cladosporium herbarum*. King's Cliffe, Norths. Rev. M. J. Berkeley." Or interpreted in part: conidia long narrow obclavate, 5-11-septate, the conidium body somewhat longer than the beak portion.

Wiltshire (l.c.) deduced that this name and description apply to the longest-spored species of *Alternaria* known to occur on *Brassica* species; he gave no specific reasons for the decision. I consider his choice supportable and the correct name for the fungus to be *Alternaria brassicae* (Berk.) Sacc. (1880c), because of the single character "conidium body somewhat longer than the beak." The 5-11 septa and the long narrow appearance of the conidia, as given in the type description, could apply to conidia in field material of both *A. brassicae* and *A. brassicicola*; however, the very long conidia of *A. brassicae* usually include a robust, apically tapered, poorly septate portion that constitutes about 1/3 of the total spore length, whereas conidia of *A. brassicicola* have no definable beak region except when short, usually 1-celled

secondary conidiophores develop during the process of chain proliferation.

The difference between *A. brassicae* and *A. brassicicola* was established definitively by Wiltshire. Two other pathogens of Brassicaceae, *A. cheiranthi* (Lib.) Bolle (1924; *Alt.T&V* 123) and *A. japonica* Yoshii (1941; *Alt.T&V* 130) (syn. *A. raphani* Groves & Skolko [1944]), also are fairly well understood on the basis of modern illustrations and descriptions. These four species encompass a high percentage of the 60+ names that have been published for phaeodictyosporic species on brassicaceous plants. But they do not account for all of them; and most particularly they do not account for the minimally characterized species that Saccardo misinterpreted when he catalogued and devised a description for "*Macrosporium brassicae* Berk." in his *Sylloge Fungorum* (vol. 4, 1886).

Wiltshire went far toward explaining and assigning blame for a taxonomic situation that has led to the existence of about 30 names assignable as synonyms to *Alternaria brassicae* and *A. brassicicola*. He regretted Saccardo's errors in particular; but he failed to note that Saccardo's most significant error, involving *M. brassicae* Berk., actually originated in England with M. C. Cooke (1877), who had illustrated two comparatively small *Alternaria*(?) conidia and had misidentified them as *M. brassicae* Berk. in his paper "On Black Moulds."

This historical disquisition needs to continue somewhat on this point in order to sort out Saccardo's precedents and subsequent handling of relevant names in the period 1880-1886 and to set a basis for defending the extensive synonymy presented below.

As a starting point, one of Wiltshire's views began (1947, p.1): "There are two species of *Alternaria* found on species of *Brassica* which are confused more than any other two species in this genus." The post-Saccardo confusion, however, was of names, not of the two fungi themselves, which we now refer to as *A. brassicae* and *A. brassicicola*. The name-jugglers who followed Saccardo were for the most part clear on the two species they thought were involved, but they were still struggling as late as 1945 (Jørstad) and 1958 and 1959 (Sawada) to come to terms with the Saccardo (1880c, 1886) handling of names, particularly of the entity "*Macrosporium brassicae* Berk.," which lacked reference specimens, authentic illustrations, and a definitive type description.

The central clue to resolution of this muddle is the fact that Saccardo believed he was cataloging and characterizing three, not just the generally assumed two, different species of *Alternaria/Macrosporium*.

1. Saccardo at first reported (1880b; Michelia 2: 129) on material that he identified as *Macrosporium brassicae* Berk., with conidia 120-140 x 20-25 μ m, 6-8-septate, and queried "*An Alternariae species?*" In 1886 (Syll. 4: 546) he referred to this 1880 source in establishing *A. brassicae* (Berk.) Sacc. var. *macrospora* Sacc. The specimen itself, "*In foliis Brassicae oleraceae. Mb. [Malbranche],*" came from Rouen, France; it is the holotype of *A. brassicae* var. *macrospora* Sacc. (PAD; EGS 38-158). Saccardo's conidium measurements match those of the most abundant conidia present but not of the scarce largest ones, some of which are as long as 170-200 μ m. The fungus is typical large-spored *A. brassicae* as we now interpret the species.

2. Saccardo soon thereafter (1880c; Michelia 2: 172) also introduced *Alternaria brassicae* (Berk.) Sacc. [var.] **minor* Sacc., with conidia 60-80 x 14-18 μ m, 6-8-septate, and supported the concept with a good illustration (1881, *Fungi italici* del. 736) that is recognizable as what we now call *A. brassicicola*. In 1886 (Syll. 4: 546) this variety "*minor*" disappeared in favor of simply *A. brassicae* (Berk.) Sacc. (the information is the same in both places). As late as 1914 Saccardo wrote the name *A. brassicae* on herbarium specimen labels of the smaller-spored taxon that we now know as *A. brassicicola*, e.g., on a collection labeled "*Funghi di Malta no. 573, legit Caruana Gatto*" (PAD; EGS 11-118). The enormous influence of Saccardo and the *Sylloge Fungorum* spread this specific error worldwide.

3. In 1886 (Syll. vol.4) Saccardo compiled three names immediately pertinent to this review. *Macrosporium brassicae* Berk. (Syll. 4: 526) was given the meager characterization used by Berkeley (1836) plus the dimensions of conidia illustrated and labeled "*Macrosporium Brassicae* Berk., from Britain" by M. C. Cooke in his paper "*On Black Moulds*" (1877, Pl. 26, fig. 21). The conidium dimensions were calculated from Cooke's figure as 50-60 x 12-14 μ m. Saccardo duly noted the two sources of his information as "...Berk. in Sm.[ith's] Engl. Fl. V, p. 339, [and] Cooke *Black Moulds* t. XXVI, f. 21." (This two-source concept has no taxonomic meaning and no nomenclatural standing; Cooke's small-spored species, known only through his illustration of two conidia, is unidentifiable today.) Saccardo's misguided idea of *M. brassicae* Berk. as having such small,

solitary conidia gave him the opportunity to use a second name *Alternaria brassicae* (Berk.) Sacc. (Syll. 4: 546) for a different species with chains of conidia of moderate size ("60-80 x 14-18 μ m," now attributed to *A. brassicicola*), and a third name *A. brassicae* var. *macrospora* Sacc. (Syll. 4: 546) for yet another species with larger conidia ("120-140 x 20-25 μ m," now attributed to *A. brassicae*). Saccardo's act of using a name for one fungus and a new combination derived from it for a second one is unthinkable now in ICBN terms and extraordinary if not unprecedented even in 1886.

In presenting these three entries, it escaped Saccardo that *Macrosporium herculeum* Ell. & G. Martin (Sacc. Syll. 4: 526) and *Polydesmus exitiosus* (Kühn) Kühn (Sacc. Syll. 4: 402) might be pertinent to his *Alternaria/Macrosporium* listings on *Brassica*, which is not surprising, given the unserviceable nature of the Berkeley and Cooke guidance on *Macrosporium brassicae* Berk.

Today *A. brassicae* and *A. brassicicola* are understood and correctly attributed largely through studies by Bolle (1924) and Wiltshire (1947). The original source of the mischief-making Cooke/Saccardo misconception of *Macrosporium brassicae* Berk. now is clear and can be ignored in the future. The nature of *A. brassicae* var. *macrospora* Sacc. is defined by the Malbranche specimen (cited above) whose conidia, in Saccardo's experience, were the largest of the group and, in fact, are of typical *A. brassicae*.

(A parting thought: there is nothing unusual in being able to isolate 4-5 distinct species of *Alternaria* from single autumn-chilled *Brassica* leaves, including *A. brassicae*, *A. brassicicola*, *A. japonica*, and 2-3 representatives of the *A. alternata*, *A. tenuissima*, and *A. infectoria* species-groups.)

135. *Alternaria brassicae* (Berk.) Sacc. (1880c), *Michelia* 2: 172. Fig. 112, 113

- = *Macrosporium brassicae* Berkeley, Engl. Flora 5(2), p. 339. 1836.
- = *Alternaria brassicae* (Berk.) Bolle, Meded. Phytopath. Lab. Willie Commelin Scholten 7: 27. 1924.
- = *Puccinia brassicae* Montagne, Ann. Sci. Nat., sér. 2, Bot., 6: 30. 1836.
- = *Rhopalidium brassicae* (Mont.) Mont. & Fr., in Montagne, Syll. Gen. Spec. Crypt., p. 297. 1856.
- = *Sporidesmium exitiosum* Kühn, Hedwigia 1:91. 1855.

- = *Polydesmus exitiosus* (Kühn) Rabenhorst, Klotzschii Herb. Viv. Mycol., ed. nova, no. 181. 1855.
- = *Alternaria brassicae* (Berk.) Sacc. var. *exitiosa* (Kühn) Ferraris, Fl. Ital. Crypt. I(8): 521. 1912.
- = *Alternaria exitiosa* (Kühn) Jørstad, Meld. Stat. Plantepatol. Inst. (Oslo), nr. 1. p. 94. 1945.
- = *Macrosporium herculeum* Ellis & Martin, American Naturalist 16: 1003. 1882.
- = *Alternaria herculea* (Ell. & Mart.) Elliott, Amer. J. Bot. 4: 472. 1917.
- = *Cercospora bloxami* Berkeley & Broome, Ann. Mag. Nat. Hist., ser. 5, 9: 183. 1882.
- = *Cercospora lepidii* Peck, Annual Rept. New York State Mus., 35th (1881), p. 140. 1884.
- = *Alternaria brassicae* (Berk.) Sacc. var. *macrospora* Sacc., Syll. Fung. 4: 546. 1886.
- = *Alternaria macrospora* (Sacc.) Sawada, Rep. Dept. Agr. Gov. Res. Inst. Formosa 51: 123. 1931.
- = *Alternaria saccardoi* Sawada, Spec. Publ. Natl. Taiwan Univ. Coll. Agric. 8: 208. 1959.
- = *Macrosporium brassicae* Berk. var. *macrospora* Eliasson, Bih. Kongl. Svenska Vetensk.-Akad. Handl. Bot. 22 (III, 12): 18. 1897.
- = *Macrosporium macrosporum* (Eliasson) Sawada, Bull. Gov. Forest Exp. Sta. 105: 101. 1958.
- = *Sporodesmium onnii* Karsten, Medd. Soc. Fauna et Flora Fennica 18: 67. 1891.
- = *Sporodesmium brassicae* Massee, Kew Bull. 1901: 153. 1901.
- = *Alternaria alliariae-officinalis* Săvul. & Sandu, in Săvulescu, Herb. Mycol. Romanicum, fasc. 9, no. 447. 1932.
- = *Cercospora moldavica* Săvul. & Bontea, in Săvulescu, Herb. Mycol. Romanicum, fasc. 27, no. 1336. 1947.

Alternaria brassicae is a striking, very frequent component of the fungus flora of many unprotected brassicaceous crops, particularly of common head cabbage grown under cool, moist climatic conditions. Under optimum sporulation conditions leaf lesions may be covered with a solid stand of relatively large, sturdy-beaked conidia.

In nature, juvenile conidia ca. 60-85 x 13-15 μ m have 3-6 transverse septa and at this stage already are developing from a narrowly ovoid, almost ellipsoid form into a narrowly obclavate one as the conidium apex begins production of a discernible true beak. The sturdy beak, never fragile or filamentous, increases in length as the spore body continues to enlarge and produce additional septa.

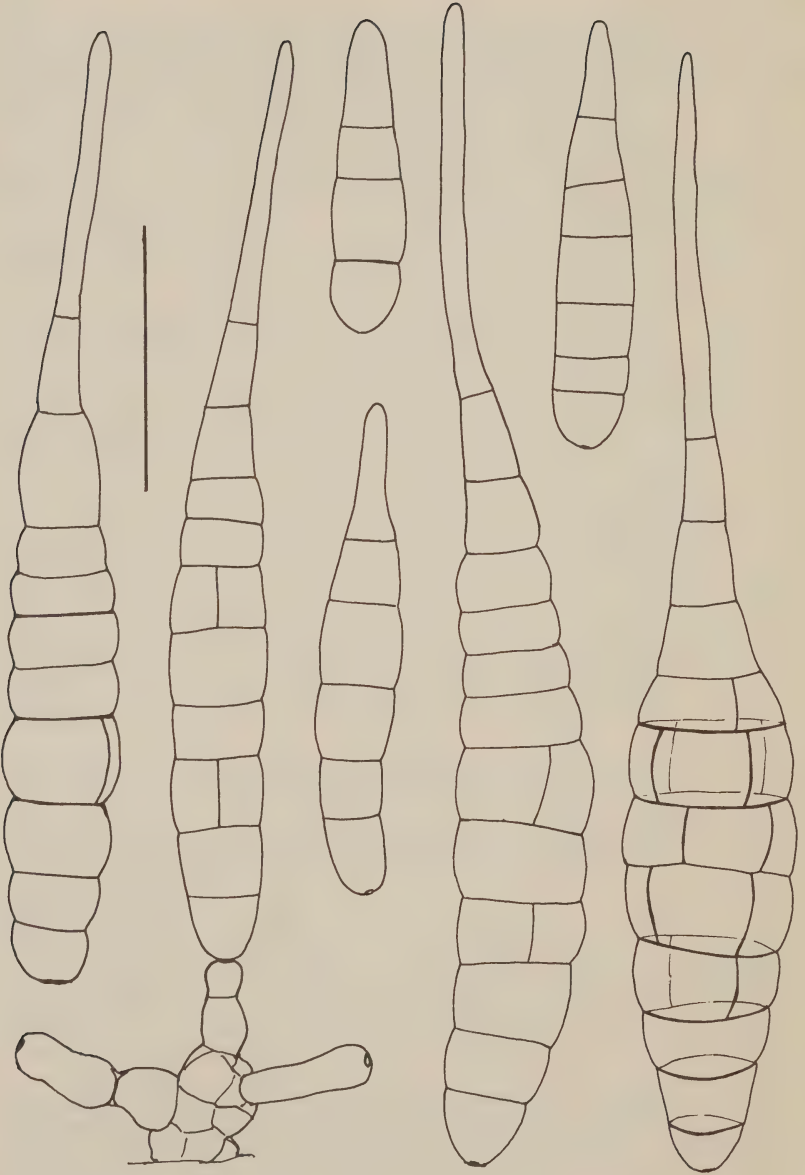


Fig. 112. *Alternaria brassicae*: conidia and conidiophores ex representative field specimen EGS 38-032. Bar = 50 μ m.



Fig. 113. *Alternaria brassicae*: conidia ex representative isolate EGS 38-032 (4-7d PCA). Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

Conidia usually are solitary at the conidiogenous apex of simple or geniculate conidiophores; secondary conidium production occurs in nature but is not a dominant character on the natural substrate. Fresh mature conidia are dilute straw-colored to pale greenish tan; the surface of fresh, mature but not overdeveloped conidia appears to be quite smooth.

The natural conidium population contains spores in all degrees of long obclavate form, with a high proportion of mature conidia in the range of $250-300 \times 35-40\mu\text{m}$, commonly with ca. 12 constricting transverse septa and usually only one longiseptum in a few transverse segments (or 2 in a few transverse segments of the broadest conidia). The sturdy beak, usually without transverse septa, commonly makes up about one-fourth to one-third of the mature spore length.

The major differences between sporulation usually found in nature and that developed in culture are that (in culture) chain formation of 2-3 conidia becomes a dominant character, strikingly long secondary conidiophores are produced by a large proportion of conidia, and conidium color deepens to a medium olivaceous brown. Greatest conidium body length is about the same in both nature and culture (ca. $150-200\mu\text{m}$); the sturdy beak typical of field material is retained in culture, or is replaced by a short 1-celled secondary conidiophore, or is converted into a sturdy, simple or geniculate secondary conidiophore ca. $5-8\mu\text{m}$ wide and as short as $10\mu\text{m}$ or as long as or longer than the spore body.

The taxon has been treated especially well in description and illustration by Wiltshire (1947), who apparently recognized the instructive value of illustrating the conidial apparatus not only as it occurs in nature but also as it is influenced by conditions of laboratory culture. The descriptive treatment of Neergaard (1945) emphasizes the nature of conidia produced in culture, particularly the abundance of secondary conidiophores; M. B. Ellis (1971) emphasizes characters of conidia from natural substrates.

Each of these treatments, as well as mine above, gives a reliable view of the taxon as long as the presentation bias of each (field and/or culture) is recognized.

XX. DIGRESSION INTO NIMBYA

Sporidesmium scirpicola Fuckel (1863) was the earliest of a few taxa described with a combination of conidium characters suggestive of both *Alternaria* and *Drechslera* to modern students of the group. I found the combination of characters too miscellaneous for *Drechslera* and unacceptable for *Alternaria*, and described a new genus *Nimbya* Simmons (1989), with *N. scirpicola* (Fuckel) Simmons as type and with four additional taxa to bolster a genus concept.

Since *Nimbya* and related taxa once placed in *Alternaria* and *Macrosporium* were initially discussed elsewhere than in this series of *Alternaria* notes, it is convenient, perhaps helpful, to repeat the generic characterization below and to add some notes and a few more species here.

Most of the taxa originally assigned to *Nimbya* occur on species of Cyperaceae and Juncaceae (*Carex*, *Eleocharis*, *Juncus*, *Scirpus*). Only *N. gomphrenae* (Togashi) Simmons, widespread on *Gomphrena globosa*, was described in the earlier treatment as occurring on a member of another host family, the Amaranthaceae. Subsequent search and gifts of material have yielded additional taxa from genera of Amaranthaceae (*Alternanthera*, *Celosia*, *Froelichia*).

Species of *Nimbya* have tetric or restrictedly blastic conidia that are solitary or catenate, long obclavate, short to long rostrate, and initially distophragmoseptate becoming rarely, partially, or completely euphragmoseptate. Longitudinal or oblique partition of a cell lumen occurs rarely. A striking character is the internal compartmentalization of conidia into numerous angular to rounded cells that are connected by narrow channels through the surrounding distoseptum matrix. Additionally, known teleomorphs of *Nimbya* are species of ascocarpic *Macrospora* Fuckel, a genus markedly different from *Alternaria* teleomorphs in *Lewia* Barr & Simmons (Simmons 1986).

136. *Nimbya gomphrenae* (Togashi) Simmons (1989), Sydowia 41: 324. Fig. 114

= *Alternaria gomphrenae* Togashi, Bull. Imp. Coll. Agr. & For. (Morioka) 9: 6. 1926.
= *Pseudocercospora gomphrenicola* Chiddarwar, Sci. & Cult. 22: 511. 1957.

At the time of publishing on this species in 1989, no isolate of the few in my hands was in sporulating condi-

tion. Since then fresh material on *Gomphrena globosa* leaf-spots and new isolates have become available from Florida, U.S.A., and from Thailand. The Florida isolate deteriorated rapidly in serial culture. Several isolates from Thailand material initially sporulated abundantly on sparse mycelium under routine culture conditions. Serial transfers have led to even scantier growth and poor sporulation, with considerable aberration in conidium morphology as compared with the initial cultures.

Conidia illustrated with the type description (Togashi 1926) are markedly distoseptate, with up to 12 angular to rounded lumina separated only rarely by 1-2 transverse eusepta. Each conidium has a rather stiff narrow beak ca. 0.5-1.0X the length of the conidium body.

Numerous field specimens examined (Simmons 1989) have similar conidia with series of well-defined, strongly angular lumina with narrow connectives and rarely with 1-2 transverse eusepta. Conidia of the type and other sporulating field specimens characteristically are long and narrow, up to ca. 150-170 x 8-13 μ m.

More recent isolates (Thailand, EGS 40-146) produce conidia that have a short-broad appearance disconcertingly different from the usual field spores. Their cell lumina are broadly octagonal, abutting the conidium outer wall and each other rather than appearing as linear series of strongly incised cell units surrounded by a distoseptum matrix. Only the first flush of conidia on *Gomphrena* lesions held overnight in a damp chamber exhibit strongly angular lumina. This striking character rarely is seen in conidia from 4-6d PCA cultures.

Conidia produced in PCA culture are borne singly on simple erect conidiophores. Juvenile conidia are ovoid to obclavate to broadly elliptical; interior compartmentalization but not euseptation is visible when conidia are no more than 20 μ m long. Development of a narrow, rather stiff apical beak often begins when a conidium is about 50 μ m long. The spore body of fully developed conidia is ca. 80-100 x 18-20 μ m, the beak ca. 60-80 x 2 μ m. The 7-10 compartments in conidia produced in culture appear broadly octagonal, reaching the full width of the spore body. Transverse eusepta may be formed, usually across one or two of the basal distosepta, then through one or two others. Longitudinal eusepta have not been seen but rarely there is a vertical or oblique partition, which actually is the interface of two cells formed by division of one of the



Fig. 114. *Nimbya gomphrenae*: conidium left of bar ex field specimen EGS 16-129; 4 juveniles at lower right <24hr old, produced on lesion, damp chamber overnight (EGS 40-145); others, isolate EGS 40-146 (ex 40-145) (4d PCA). Bar = 50 μ m.

widest cell lumina. The outer wall of young conidia sometimes is minutely ornamented, but that of fully developed spores appears smooth, dilute gold-tan, and almost imperceptibly constricted only where eusepta have formed.

137. *Nimbya alternantherae* (Holcomb & Antonopoulos) Simons & Alcorn, comb. nov. Fig. 115

Basionym: *Alternaria alternantherae* Holcomb & Antonopoulos, Mycologia 68: 1126. 1976. Neotype: BPI dried-down culture EGS 39-124 ex ATCC 32833 ex Holcomb and Antonopoulos holotype. [LSU holotype used up in isolation work.]

An isolate from leafspot of *Alternanthera denticulata*, Queensland, Australia, arrived in March 1990 from J. L. Alcorn with the suggestion "*Nimbya*?" (Alcorn 8933, EGS 39-118). Long, narrow, distoseptate, tardily euseptate conidia with extremely long narrow beaks defined the isolate as a *Nimbya* and suggested a possible resemblance to *Alternaria alternantherae* on *Alternanthera philoxeroides* in Louisiana, U.S.A. The original Louisiana material had been used up in isolation work, so derivative cultures proved to be the major link to the type.

Conidia and their apical beaks, as originally illustrated (Holcomb and Antonopoulos 1976), exhibited so many and various swollen cells that experience suggested internal parasitism as an explanation. Culture and 1-conidium reisolation of the ATCC lyophil preparation demonstrated that the ex-type isolate is culturally unstable (some sectors of non-sporulating aerial mycelium) but that, after reisolation, it can produce enormous numbers of conidia from solid stands of surface conidiophores within 2-4d on PCA and V-8 agars. The isolate from Australia performs in essentially the same manner.

The ex-type reisolates in recent cultures reveal that the taxon is a typical *Nimbya* and that conidium and beak structure and development are considerably more uniform than initial type illustrations indicate. Certainly the kinds of swollen, euseptate conidium cells originally photographed can be found. But they tend to gain prominence in aging cultures (Holcomb and Antonopoulos mention 6-wk-old conidia) rather than in vigorously sporulating colonies a few days old.

Conidia of *N. alternantherae* (PCA 5-7d) are narrow-ovoid, up to ca. 50-60 x 8-10 μ m when internal comparten-



Fig. 115. *Nimbya alternantherae*: 2 partial conidia at lower right from ex-type isolate ca. 30d PCA (EGS 39-124); all others from same source, 7d PCA. Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

talization becomes visible. Apical beak formation may begin before lumina form or only after the conidium body has reached sizes near $70-75 \times 18-20 \mu\text{m}$. Cell lumina in ex-type conidia tend to be broadly octagonal to rounded at all stages of development in culture (field conidia not seen). Lumina of both conidia and conidiophores are distinctly angular and well separated in the Australian field material, but they also become octagonal, rounded, and crowded in conidia produced in culture.

Largest conidia contain 6-10 cells, in 1-2 of which a longitudinal division (not euseptum) may occur. True transverse septa, distinct from lumen interfaces, are rare in conidia produced in developing ex-type colonies (4-7d PCA); 2-3 eusepta can be found in conidia from colonies about 2 wks old. Conidium bodies become as large as $80-115 \times 18-20 \mu\text{m}$ and characteristically generate unbranched septate beaks $350-470 \times 2-4 \mu\text{m}$. Conidium walls are essentially smooth; only rarely does a conidium have minor areas of punctulate roughness.

A peculiarity of conidium beaks in *N. alternantherae* is a conspicuous enlargement of the apex, ca. $4 \mu\text{m}$ in a beak $2 \mu\text{m}$ diam. Such swellings do not necessarily remain terminal, for intermittent renewal of beak growth often results in 5-6 successive regions of narrow beak interrupted by a series of apical swellings, each delimited by a septum in the long beak. Rare chains of two conidia can be seen at 50X within the population of predominantly solitary spores.

138. *Nimbya celosiae* Simmons & Holcomb, sp. nov. Fig. 116

Culturis in agar PCA descripta. Conidiophora simplicia, vulgo $18-50 \times 5-7 \mu\text{m}$, ad 1-2 locos conidiogenos. Conidia solitaria, rarissime 2-catenata; juventute (0-5 distoseptata) $50-60 \times 7-9 \mu\text{m}$, rostro $0-75 \times 2 \mu\text{m}$ additicio; maturitate anguste ellipsoidea vel anguste obclavata, $100-190 \times 12-17 \mu\text{m}$, rostro ad $250-470 \times 2-4 \mu\text{m}$ additicio, transverse 11-14 distoseptata et gradatim 1-3 transverse euseptata, cellula basali saepe longiangulara.

Habitatio typi in macula pallide brunnea foliorum *Celosia cristata* L., VII-1993, Baton Rouge, Louisiana, U.S.A. Typus: partes ex cultura EGS 42-013 desiccatae et in BPI (holotypus) et saltem in IMI (isotypus) conservandae.

The diseased leaf specimen from which ex-type cultures of *Nimbya celosiae* were derived was collected by G. E. Holcomb in July 1993 on the campus of Louisiana State



Fig. 116. *Nimbya celosiae*: 3 conidia right of bar ex field specimen (EGS 42-012); others ex-holotype isolate EGS 42-013 (ex 42-012) (7d PCA). Bars = 50 μ m.

University, Baton Rouge, from volunteer plants of cockscomb *Celosia cristata*. Conidia produced under natural conditions are long ovoid, ca. 60-100 x 10-18 μ m plus a rather stiff beak up to 140 x 2-3 μ m. The conidium body exhibits 8-10 broadly octagonal to rounded lumina crowded in a linear series. Usually 2-3 tranverse eusepta are present. A longitudinal division of a single lumen is found in some conidia. Conidium walls are dilute yellow-tan and smooth.

Field lesions held in a damp chamber readily produced abundant distoseptate, long-beaked conidia within 48 hrs.

Juvenile conidia (PCA cultures) are long obclavate, almost naviculate, 50-60 x 7-9 μ m, until initiation of long, narrow beaks. Lumina form rapidly within the distoseptum matrix as the conidium enlarges. Conidia sampled at 7d on PCA are predominantly narrowly ellipsoid with spore body 100-190 x 12-17 μ m plus beak up to 250-470 x 2-4 μ m. Largest conidia have 12-15 broadly octagonal to rounded lumina in a longitudinal series. Eusepta are visible through 1-3 distosepta; longitudinal division of 1-3 lumina may occur. The basal cell of a high percentage of conidia is strikingly long and narrow (ca. 14-18 x 5-8 μ m) in a population of conidia that usually mature with broadly rounded basal cells. The conidium wall usually is smooth but sometimes is minutely but distinctly punctulate; color is medium golden-tan. The beak apex of large conidia often terminates in a swelling ca. 3-4 μ m diam. There is evidence of terminal swelling and successive renewed beak growth and terminal swelling in longest beaks, much as is found in *N. alternantherae*. Chains of two conidia are produced very rarely.

139. *Nimbya crassoides* (J. J. Davis) Simmons, comb. nov. Fig. 117

Basionym: *Cercospora crassoides* J. J. Davis, Trans. Wis. Acad. Sci. 21: 298. 1924. Holotype: WIS, leg. J. J. Davis, 23 July 1921, on *Froelichia floridana* (Nutt.) Moq.

Davis (1924), Chupp (1953), and Deighton (in litt. to EGS Nov. 1970) all expressed some concern that this taxon might be an *Alternaria*. Chupp even wrote that "The type shows this to be an *Alternaria*," but he did not make a nomenclatural combination or transfer to the genus. Davis collected the species at least four times in Wisconsin on leaves of *Froelichia floridana* and H. C. Greene collected it at least once on the same host at one of Davis's sites. The five specimens at WIS (EGS 29-196/200) all bear material of the same fungus taxon. The Davis specimen packet

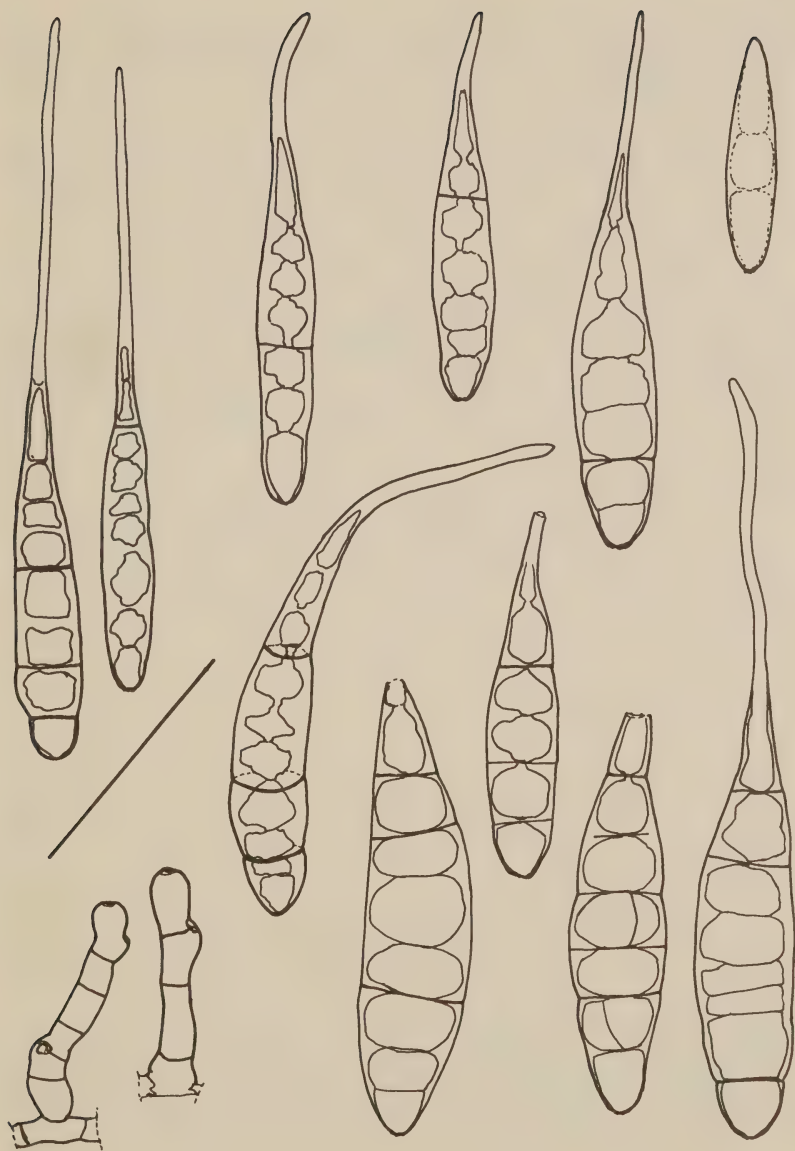


Fig. 117. *Nimbya pimpriana*: 2 conidia at upper left ex lectotype (IMI; EGS 24-033). *Nimbya crassoides*: all other conidia and conidiophores at right and bottom ex lectotype (WIS; EGS 29-196). Bar = 50 μ m.

dated 23 July 1921, containing his manuscript notes and being the best of two syntype collections mentioned in the type description ("July 23 and 25, 1921"), is selected here as lectotype (WIS; EGS 29-196).

Conidia found on a leafspot of the lectotype are much as Davis described them: "ferruginous, lanceolate, 6-8 septate, tapering into a flagelliform distal portion about as long as the body, $100-165 \times 13-7\mu$ " [presumably $13-17\mu$].

Additional observations are as follows. Young long-ovoid, beakless conidia ca. $45 \times 8\mu$ already are 2-distoseptate, i.e., with 3 cell lumina. Beak formation begins on slightly larger conidia. The conidium bodies of fully developed conidia are ca. $65-90 \times 15-20\mu$, with beaks ca. $40-60 \times 2\mu$, giving a total length of ca. 150μ or more (beaks of largest conidia sometimes have broken off). There are as many as 7-9 transverse distosepta, with eusepta through 1-4 of these. Vertical partition of a cell lumen is rare but has been seen in as many as 2 transverse segments of a single conidium. Cells in conidia of medium size are strongly angular and well separated except for a narrow channel between adjacent ones; they become octagonal to fully rounded and crowded as the spore body enlarges. Conidia are a dilute gold-tan in color, with eusepta appearing slightly darker in edge view.

140. *Nimbya pimpriana* (V. G. Rao) Simmons, comb. nov.

Fig. 117

Basionym: *Alternaria pimpriana* V. G. Rao, Current Science 32: 84. 1963. Lectotype: IMI 103781, on *Celosia cristata* L., coll. Pimpri, near Poona, India, Vasant Gurunath Rao, 15 Aug. 61 (M.A.C.S. no. 110).

The figure accompanying the type description of *A. pimpriana* illustrates long narrow conidium bodies with equally long or longer stiff narrow beaks; inclusive measurements given are $205.8-260.5 \times 12.5-17\mu$. The internal septation, given as 5-13 transverse and 1-2 longitudinal, is drawn as being distoseptate, i.e., with a chain of lumina embedded in the distoseptum matrix of the spore body; no transverse eusepta are shown. The appearance, as illustrated by Rao, is of a typical *Nimbya*.

Portions of the type collection are HCIO 28182 (EGS 29-128) and IMI 103781 (EGS 24-033). Ex-type isolates used by Rao in inoculation experiments are not found listed in available culture collection catalogues.

The long-spored taxon described by Rao was not found on the HCIO holding. The IMI portion of the collection bears a few typically euseptate *Alternaria* conidia that are smaller than and quite distinct from a few *Nimbya* conidia present, which can be identified with the type description of *A. pimpriana*. Such of the latter conidia as are present on the IMI portion are designated here as lectotype of the species.

The two conidia illustrated in Fig. 117 are the only ones I have seen in the lectotype. They differ from those in the Rao illustration in having distinctly angular lumina (Rao drew them as being rounded), transverse eusepta through 1-3 of the 7-9 distosepta, and nothing suggesting a longitudinal septum. The scanty evidence of the *N. pimpriana* lectotype conidia does not permit significant comparison with other species of *Nimbya* already described.

XXI. OTHER TAXA OF THE 1816-1871 PERIOD OF ALTERNARIA/MACROSPORIUM CHRONOLOGY

141. *Thyrostromella heterospora* (Desm.) Simmons (1995),
Mycotaxon 55: 27. Fig. 118

= *Macrosporium heterosporum* Desmazières, Ann. Sci.
Nat., ser. 3, Bot., 18: 358. 1852.

The type specimens of both *Thyrostromella myriana* (Desm.) Höhnelt (1919), the type of the genus, and *T. heterospora* were described from collections on "*Calamagrostis arenaria*" [*Ammophila arenaria* (L.) Link]. The type specimen of *T. myriana* occurred as tiny black dots on dry leaves and culms in the summer, whereas *T. heterospora* occurred under moist conditions in the autumn as effuse velvety growths on dead leaves found after they had been torn or cut off and discarded on the ground. (See Alt. Chronology 1852 for lectotypification.)

Initial reaction to the presence of these congeneric taxa on the same substrate species might be to suspect that they are simply different age and developmental stages of one species. However, the patterns of conidium development in the two taxa are different, and the size and septation of largest conidia of the two are markedly different.

Conidia of *T. myriana* (Fig. 118) become phaeodictytic, with three transverse and 1-2 longitudinal or oblique septa, and at largest size about 32 x 19 μ m. Desmazières

(1852) gave the size as $30 \times 15\mu\text{m}$; Hughes (1955), working from part of the type collection, gave $21\text{-}32 \times 13\text{-}19.5\mu\text{m}$.

Conidia of *T. heterospora* become complexly cellular, with as many as 6-7 major and several minor transepta and numerous series of oblique and longitudinal septa. The conidia commonly are as large as $50 \times 33\mu\text{m}$ and exhibit all the several shapes noted by Desmazières: rounded, ovoid,

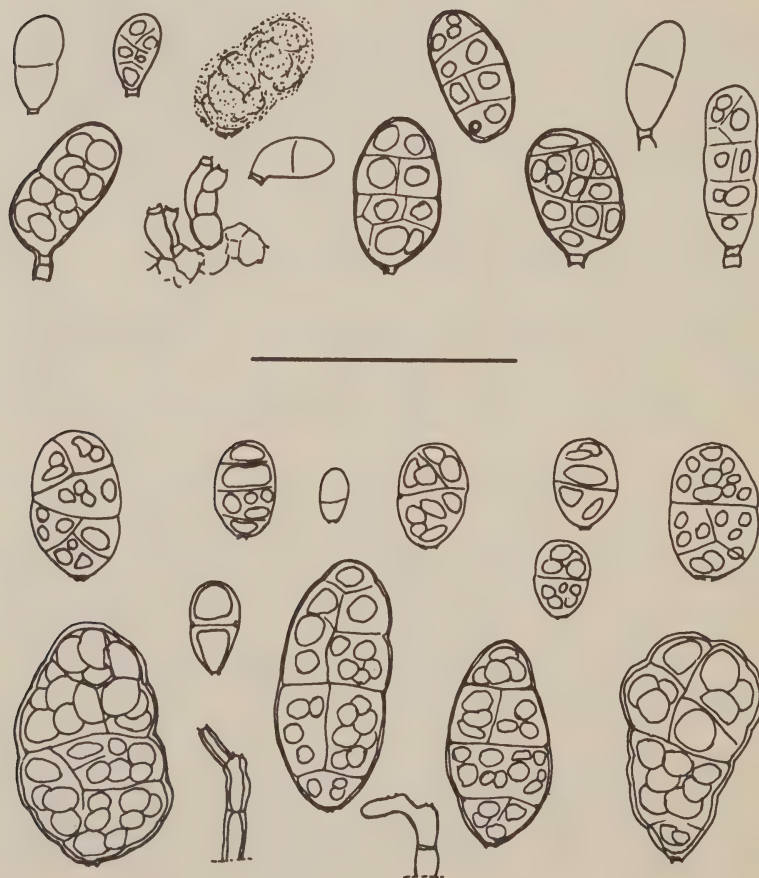


Fig. 118. *Thyrostromella heterospora*: conidia and conidiophores below bar ex lectotype (PC; EGS 12-049). *Thyrostromella myriana*: conidia and conidiophores above bar ex lectotype (PC; EGS 09-191). Bar = $50\mu\text{m}$.

oblong, or pyriform. Some have a bluntly obconic apex, and at least one conidium has been seen to produce a secondary apical conidiophore.

Although *T. heterospora* was described initially as a *Macrosporium* and was considered by Desmazières to be similar to *M. cheiranthi* (= *Alternaria cheiranthi*), conidium production in *Thyrostromella* is distinctly blastic and conidium secession rhexolytic and, thus, is fundamentally different from the sort of apparently tretic or porogenic conidiogenesis found in *Alternaria*. I have not seen fresh material or a living isolate of any *Thyrostromella* species.

142. *Alternaria dauci* (Kühn) Groves & Skolko (1944),
Canad. Journ. Res., C, 22: 222. Fig. 119

- = *Sporidesmium exitiosum* Kühn var. *dauci* Kühn, Hedwigia 1:91. 1855.
- = *Polydesmus exitiosus* (Kühn) Rabenh. var. *dauci* Kühn, in Rabenhorst, Klotzschii Herb. Viv. Mycol., ed. nov. Cent. II, no. 182. 1855.
- = *Macrosporium dauci* (Kühn) Rostrup, Tidsskr. Land-økonomi, ser. 5, 7:385. 1888.
- = *Alternaria brassicae* (Berk.) Sacc. var. *dauci* (Kühn) Lindau, in Rabenhorst's Kryptogamen-Flora, Pilze, Abt. IX, p. 260. 1908.
- = *Alternaria brassicae* (Berk.) Sacc. var. *dauci* (Kühn) Bolle, Meded. Phytopath. Lab. Willie Commelin Scholten 7: 42. 1924.
- = *Alternaria porri* (Ellis) Ciferri f. sp. *dauci* (Kühn) Neergaard, Danish Species of *Alternaria* and *Stemphylium*, p. 252. 1945.
- = *Macrosporium carotae* Ellis & Langlois, Journ. Mycology 6: 36. 1890.
- = *Alternaria carotae* (Ell. & Langl.) Stevenson & Wellman, Journ. Wash. Acad. Sci. 34: 263. 1944.
- = *Alternaria carotae* (Ell. & Langl.) Ciferri, Atti Ist. Bot. Lab. Critt. Pavia, ser. 5, 19: 86. 1962.

The carrot pathogen now known correctly as *Alternaria dauci* was the first taxon of the genus to be described and differentiated largely on the basis of conidia with long, narrowly tapered to filiform beaks. Kühn (1855) used the filamentous beak character to distinguish *A. dauci* from another large-spored species known to him which, however, has conidia gradually tapering into a broad, blunt-tipped apical region, *Alternaria brassicae* (Berk.) Sacc. (syn. *Sporidesmium exitiosum* Kühn [1855]).

The legitimacy of "*dauci*" as a species epithet in *Alternaria*, instead of the variety or forma specialis status used by Kühn, Lindau, Bolle, and Neergaard, has a very flimsy basis in a few words of E. Rostrup (1888): [transl.] "the fungus is a species of black mold, *Macrosporium dauci*, which was described by Jul. Kühn 30 years ago, however under another poorly chosen name."

"*M.[acrosporium] dauci* (Kühn) Rostrup" would have serious problems of legitimacy as a new combination under modern ICBN rules, even with the Art. 32 loophole of "indirect reference"; and, being familiar with J. W. Groves' respect for matters nomenclatorial, I suspect that he adopted the Rostrup note rather gingerly. In any case, the name *A. dauci* (Kühn) Groves & Skolko has been thoroughly accepted in the literature for 50 years. It probably can be justified, if only marginally, within ICBN rules. I find no reason to reconsider its use.

Use of the next chronologically pertinent name for the same fungus, *A. carotae* (Ell. & Langl.) Stevenson & Wellman (1944), cannot now be justified and probably never could have been, even with the rather loose ICBN rules of 1944, in that the complete entry reads simply "*Daucus carota* L. Carrot. *Alternaria carotae* (Ell. & Langl.) Leaf blight occurred at La Ceiba, no. 33; Volcano San Salvador, no. 341."

The following observations are based on cultures of a representative isolate EGS 37-036 from carrot leaves (recd December 1983, J. Strandberg, University of Florida Institute of Food and Agricultural Sciences, Sanford, Florida).

Alternaria dauci grows well and sporulates abundantly on PCA and V-8 agars; growth and sporulation on Hay agar are thin and sparse. Conidiophores produced on PCA are erect, 30-100 x ca. 5µm, medium olivaceous brown, and either simple, with a single terminal conidiogenous site, or 1-2 geniculate and conidiogenous.

Conidia are predominantly solitary, but a primary conidium occasionally (uncommonly) produces a sturdy terminal secondary conidiophore and subsequent secondary spore with the usual filamentous beak. Juvenile ovoid conidia as short as 20µm initiate a primary transverse septum and an apical, narrow beak at about the same time. By the time a young conidium is about 30µm long, 2-3 transepta and a filamentous beak ca. 50µm long may have been produced; concurrently, the conidium body becomes



Fig. 119. *Alternaria dauci*: 2 partial conidia upper left ex lectotype (B; EGS 10-095); others ex representative isolate EGS 37-036 (young 1-4hr PCA, mature 8d PCA). Habit: conidia (opaque) and conidiophores (clear). Bars = 50 μ m.

evenly minutely punctulate.

Conidium enlargement and beak extension remain concurrent until a high percentage of conidia become ca. 80-100 x 15-24 μ m (spore body) with a major filamentous beak as long as 200-250 μ m x 5 μ m tapering distally to ca. 2 μ m; the major beak often has a single lateral branch, commonly up to ca. 100 μ m but sometimes twice as long.

Conidium bodies at greatest development are long ellipsoid to obclavate, with 8-11 transverse septa and usually only 1, rarely 2-3 longitudinal septa in fewer than half of the transverse segments. Young-mature conidia are a dilute yellowish tan, which becomes medium to dark olivaceous brown at full development. Some conidia produced in colonies on PCA may appear smooth, but most of them are minutely, evenly punctulate or occasionally even more distinctly ornamented. Conidia produced on V-8 agar have relatively inconspicuous ornamentation or are smooth, as are those produced on host leaves in nature.

143. *Alternaria ulmi* (Fuckel) Simmons (1995), Mycotaxon 55: 42. Fig. 120

= *Sporidesmium ulmi* Fuckel, Jahrb. Nassau. Ver. Naturk. 23-24: 350. 1870.

This taxon, described from an effuse velvety growth on dead portions of *Ulmus* leaves, has been brought into *Alternaria* to represent a species not otherwise described before 1870. Type material was distributed in Fuckel's *Fungi Rhenani exsiccati* no. 2210 (1869) (G; EGS 09-187). The species has played almost no part in either mycological or phytopathological literature. The possibility of this fungus having developed in a parasitic mode on elm leaf-spots is problematic, in that the fungus growth on the original substrate is a mosaic of *Cladosporium*, *Stemphylium*, and the plentiful *Alternaria*.

Most conidia of *A. ulmi* are bluntly tapered and rarely have a terminal pore, thus are solitary or rarely short-chained in the type specimen. Young conidia are sublanceolate (apex blunt rather than pointed), and have 7-8 transverse septa when a single longiseptum is produced in one of the median segments. Largest conidia remain narrowly to broadly lanceolate or obclavate as they mature, and are 70-95 x 17-22 μ m, with 9-13 complete or partial transepta and 1-3 longitudinal or oblique septa in most of the transverse segments. Conidia are yellowish tan and



Fig. 120. *Alternaria ulmi*: conidia ex lectotype (G; EGS 09-187. Bar = 50 μ m.

practically smooth to evenly, inconspicuously punctulate. Fuckel described conidia as being [ob]clavate, 10-12 septate, yellow, 96-112 x 24 μ m, so there is no doubt that I have examined the same taxon he described in segregation from the original growth mixture.

144. *Alternaria putrefaciens* (Fuckel) Simmons (1995),
Mycotaxon 55: 42. Fig. 121

= *Sporidesmium putrefaciens* Fuckel, Jahrb. Nassau.
Ver. Naturk. 23-24:350. 1870.

~ *Macrosporium commune* Rabenhorst, nom. nud., Klotz-
schii Herb. Vivi Mycol. Cont. (Fungi Europ. Ex-
sicc.) no. 1360. 1870.

= *Macrosporium cheiranthi* Lib.: Fr. var. *betae* Cooke,
Handb. Brit. Fungi, p. 576. 1871.

= *Clasterosporium putrefaciens* (Fuckel) Sacc., Syll.
Fung. 4: 393. 1886.

= *Alternaria brassicae* (Berk.) Sacc. var. *putrefaci-
ens* (Fuckel) Preissecker, Fachl. Mitteil. österr.
Tabakregie 16: 14. 1916.

Fuckel (1870) described this species from leaves of *Beta vulgaris* L. collected in September in the Nassau region of Germany, where, he remarked, it was very abundant and could be recognized from a distance because of the way it overgrew and blackened the leaves. Fuckel's type collection (G; EGS 09-189) is on diseased beet leaves, but he also attributes a heart rot condition of red beet ("Herzfaule der Runkelrüben") to the fungus.

Alternaria putrefaciens is morphologically distinct within *Alternaria* and readily distinguishable from any taxon described before 1870. It is the same species as one present in the exsiccata distributed by Rabenhorst in 1870 under the nomen nudum *Macrosporium commune*. The Rabenhorst material is in turn a part of the same collection that M. C. Cooke (1866) distributed in his *Fungi Britannici exsiccati* 197 as *Macrosporium cheiranthi* Fr. and described in his 1871 *Handbook* as *M. cheiranthi* Fr. var. *betae*. *Alternaria putrefaciens* is the correct name for what once must have been, and perhaps still is, a common and distinctive beet leaf inhabitant.

Most conidia of the type collection are long, narrowly ellipsoid to somewhat obclavoid, with a moderately long, narrowly tapered (but not filiform) true beak. A few conidia remain relatively short ovoid, with an abrupt 1-celled apical secondary conidiophore instead of a tapered



Fig. 121. *Alternaria putrefaciens*: conidia ex lectotype (G; EGS 09-189). Bar = 50 μ m.

beak; some of the longest narrowly ellipsoid conidia also produce a functional secondary conidiophore extension of the narrow beak. Fully developed conidia reach ca. 80-120 x 15-18 μ m, with 10-18 transverse septa and 1-3 variously longitudinal or oblique septa in many of the transverse segments. Conidia are pale yellowish tan, slightly constricted at major septa, and essentially smooth.

Fuckel described conidia without a stipe, "*sine stipite*," as 82 x 16 μ m in size. Since the concept of a spore "stipe" for *Alternaria* at that time could refer either to a conidiophore or to a narrow beak (with reversed orientation), his measurement of 56 μ m for a stipe would bring total conidium length of ca. 138 μ m into better accord with my own observations on a very limited sampling of conidia with long-tapered true beaks.

An excellent modern specimen of *A. putrefaciens* on leaves of sugar beet was collected by W. G. Bramley in Oct. 1959 in Yorkshire, U.K. (IMI 79075a; EGS 26-042). This specimen yielded some 1-conidium isolates which, at the time, sporulated abundantly on potato-dextrose agar. The plate culture was dried down for IMI herbarium purposes and not retained in viable condition. I have not seen fresh material of *A. putrefaciens*; all of numerous attempts to find it on lesions of red beet leaves and in outgrowths from beet seeds held in damp chambers have yielded only isolates of different taxa of the *A. tenuissima* and other small-spored species groups.

Alternaria putrefaciens now gives us the correct name for a taxon originally distributed (Rabenhorst 1870) under a nomen nudum, *Macrosporium commune*, which was used indiscriminately for many decades for commonly encountered *Alternaria* species of diverse morphology.

Unfortunately, the name "*Macrosporium commune*" is as meaningless as "*Alternaria tenuis*" and currently, to a great extent, as "*A. alternata*," in the way they have been misused on innumerable specimen packets in herbaria and on cultures in use all over the world. It is unlikely that significant numbers of these orphan specimens will be re-examined and identified in modern times. But it can be hoped that attempts will be made to differentiate international research stocks of misidentified "*Alternaria alternata*" and other taxa with small to medium-size conidia as both morphological and molecular data accumulate.

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I have tried to be scrupulous in acknowledging the source of each specimen or culture cited in the accompanying text. Numerous colleagues and institutions have contributed or lent material of such high quality that my opinions, pro or con, can take their present form. Much other related material, not cited, has aided observations and decisions; I appreciate the level of professional cooperation that underlies these equally supportive gifts.

Dr. Mary E. Palm has done me the kindness, once again, of reviewing the prepublication manuscript with her customary thoroughness, using judicious queries while forgiving instances of idiosyncratic syntax. Mycology as a discipline is in considerable debt to colleagues with editorial skills of such quality, who find time in busy schedules to critique work that sometimes is only marginal to their own research. I am grateful.

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A PLASMODIOPHORID FUNGAL PARASITE OF THE SEAGRASS *HALOPHILA STIPULACEA*

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ABSTRACT

The taxonomy of a plasmodiophorid intracellular parasite on the seagrass *Halophila stipulacea* (Hydrocharitaceae) is discussed. The observed organism can be attributed to *Tetramyxa parasitica* Goebel (Plasmodiophoromycetes) on the basis of a study on cysts and biflagellate zoospores, observed here for the first time. The infection was localized in the cells of ellipsoid swellings of the leaf petiole. The cysts filled the host cells in form of single cells, dyads, triads or four celled aggregates, surrounded by a wall layer.

Keywords: *Halophila stipulacea*, Hydrocharitaceae; deformation of petioles; *Plasmodiophora halophilae*; Plasmodiophoromycetes; *Tetramyxa parasitica*.

Halophila stipulacea (Forssk.) Aschers. (Hydrocharitaceae) is a marine monocot recently recorded along the Southern coasts of Italy (Villari, 1988), after its introduction in the Mediterranean Sea (Lipkin, 1972). The plant is common in the Red Sea and the Indian Ocean. Specimens of this plant are in the MS Herbarium, both in form of *exsiccata* and as formalin-preserved plants; alterations of the normal morphology of leaf petioles were occasionally observed in form of ellipsoid swellings. These were submitted to the senior author two years after collection.

Similar modifications of the petiolar structure have only seldom been observed and attributed to the presence of a fungal parasite. In a first instance, we considered the observed parasite to be *Plasmodiophora halophilae* Ferd. et Winge, which, as far as we know, has not been recorded after its original description in 1913. Originally this fungus was found on *H. ovalis* (R. Br.) J.D. Hook., collected along the shores of the island of Noesa Kembangan, near Java (Ferdinandson and Winge, 1913).

Further observations on Italian material of the plants allowed to assign this fungal parasite to the genus *Tetramyxa* Goebel, the zoospores of

which are here reported. It seemed worthwhile to report this finding in detail.

MATERIALS AND METHODS

Individuals of *Halophila stipulacea* were collected along the East coast of Sicily at Naxos and Riposto. Voucher samples are filed in MS. Some specimens were dried and mounted on herbarium sheets, others were stored in 3% formalin in seawater. Microscopic observations were carried out with a Leitz Aristoplan with standard optics and Nomarski interference contrast. To test the viability of the parasite in samples of dried *Halophila* after fourteen months of being mounted on the herbarium sheet, two infected petioles were carefully washed in sterile distilled water and then put in a plate with sterile sea water at room temperature and dimlight, after minor wounding of the plant tissue. Further aliquots of seawater were added when necessary.

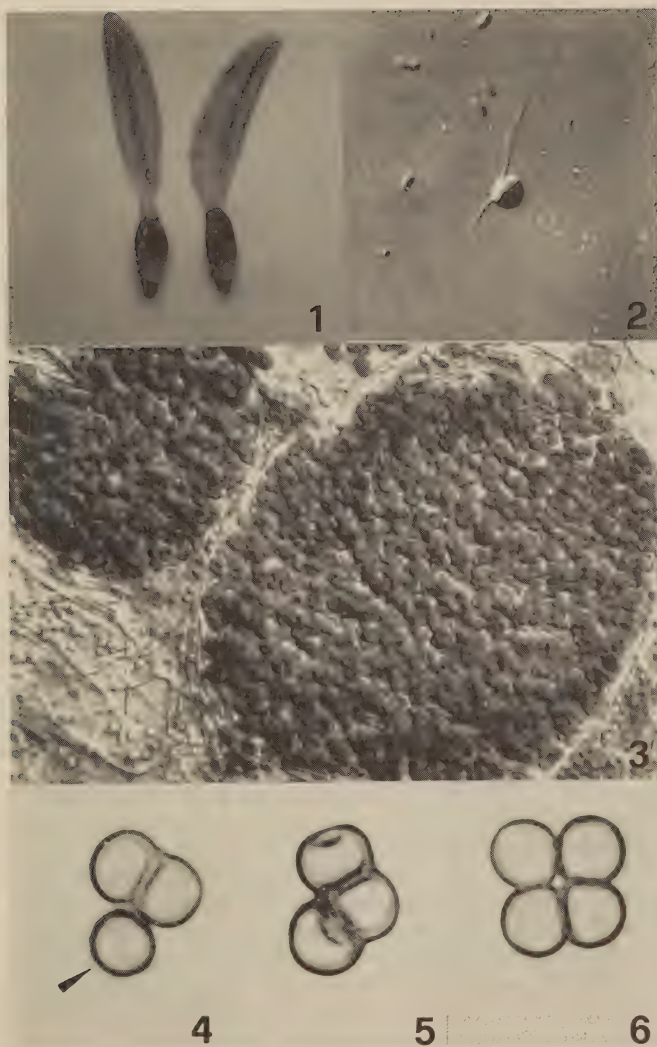
Attempts to reinfect plants of *Halophila* with zoospores were carried out in flasks of 500 ml in which fresh plants and a zoospore suspension were left for fifty days; in another experiment a drop of seawater with zoospores was applied between the stipules of an emerged plant which then was incubated as above.

OBSERVATIONS

Symptoms of the presence of the parasite (on the preserved plant material) were somewhat ellipsoid swellings involving the petioles as a whole or in their proximal or distal parts. In the latter case the lesions generally attained one third of the length of the petiole and were occasionally present also on the proximal part of the leaf lamina. They had various sizes, up to about 20 x 5 mm (Fig. 1). The swellings, frequently obscured by the large stipules of the plant, were present in less than 1% of the leaves.

In cross sections of the galls, the host tissue appeared hyperplastic with cells filled with brown resting spores (cysts) (Fig. 3). The cysts appeared globose, light brown or yellow in colour and measured 5.0-6.5 (av. 5.8) μm . Only about 20% were single, the others were aggregated in dyads (60%), triads (6%) or tetrads (11%) (Figs. 4-6); irregular aggregates of higher numbers of spores were occasionally observed (calculated from two samples with a total of 1713 observed cysts). The multiple spores did not dissociate under the pressure of the coverslip; they rather appeared surrounded by a common wall layer. No plasmodia or sporangia were observed in the host cell forming the petiolar swelling.

When the petiolar swellings after 14 months of dry preservation were incubated in seawater for a week, actively swimming zoospores were detected using Nomarski optics. They were ellipsoid or globose, 2.8-4.0 x 2.0-3.6 μm (av. 3.4 x 2.6 μm), with two simple flagella. The longer



Figs 1-6. *Tetramyxa parasitica*. Fig. 1. Leaves of *Halophila stipulacea* with petiolar swellings, x 1. Fig. 2. Biflagellate zoospore. Nomarski interference contrast, x 1300. Fig. 3. Cysts filling petiolar cells, Nomarski interference contrast, x 450. Figs 4-6. Single cyst (arrow), dyad, triad and tetrad of cysts, x 1800.

flagellum was 7-11 μm long, while the shorter one, frequently not so evident, reached 2.5-5.0 μm (Fig. 2).

Attempts to reinfect plants of *Halophila* through zoospores had no success. In both trials described no evidence of the parasite was found, also after microscopic examination of decaying plant tissue. The seawater used in these tests was that of the Bay of Naples, away from the environment where plants of *Halophila* were originally collected. This water is more strongly polluted. The zoospores appeared to be lysed after about 24 hours, although cyst germination continued for about a week.

DISCUSSION

Ferdinandson and Winge (1913) discovered *Plasmodiophora halophilae* on *Halophila ovalis* when examining plants of the H. Jensen Collection in the Botanical Museum of Hauna (New Guinea). This material had preliminarily been examined by Dr Ostenfeld, who noticed the presence of "pea-shaped tumors" on petioles of the seagrass; he recognized the parasite as a *Plasmodiophora* and sent the original material to Ferdinandson and Winge. The authors observed and illustrated, as later reported by Karling (1968), the presence in the host cell of spherical (5 μm) cysts with a thin cell wall, together with variously configured plasmodia of 30-60 μm diameter; sporangia and zoospore were not seen. Karling (1968) suggested that alterations of petiolar morphology in *Halophila baillonii* Aschers. from Guadeloupe observed by Feldmann (1936) were attributable to *Plasmodiophora halophilae*, although no direct observations of the parasite were reported. The identity of *P. halophilae* is now uncertain because of the few features available, as already stated by Cook (1933).

The samples from Southern Italy examined here show petiolar swellings slightly different from those observed on plants from Java; they were elongated rather than pea-shaped.

In addition, the cysts are somewhat larger than those of the original description. However, the most relevant feature is the aggregation of the spores in dyads, singles, tetrads and triads, in this order of frequency, while in *Plasmodiophora* they are normally single. A similar appearance of the cysts is characteristic of the genus *Tetramyxa* Goebel (Johnson and Sparrow, 1961; Karling, 1968), although in this genus frequent dissociation into single spores may occur. In the genus *Tetramyxa* four species have been described (Karling, 1968), all parasites of terrestrial or aquatic plants. The most frequent species, whose life-history has not completely been elucidated, is *T. parasitica* Goebel (Goebel, 1884), relatively rare in occurrence but widely distributed (Europe, Morocco, Japan, New Zealand, and the U.S.A.), found as agent of galls on the stalks, petioles and leaf margins of species of *Zannichellia*

(Zannichelliaceae), *Ruppia* and *Potamogeton* (Potamogetonaceae) (Dahlgren, Clifford and Yeo, 1985; Karling, 1968). *T. parasitica* has been found in Italy on *Ruppia cirrhosa* (Petagna) Grande (*R. spiralis* L. ex Dumort.) (Luther, 1949). Maire and Tison (1911) frequently observed single spores or dyads in *T. parasitica* on *R. rostellata*; in addition, Setchell (1924) reported in this species the occasional presence of complexes formed by more than four cells, like those observed by us. Maire and Tison (1911) also talk about tetrads surrounded by a common cell wall. Cysts of *T. parasitica*, in TEM show the typical tetrads completely enclosed in an outer wall, whereas each single cell has its own wall layer (Braselton, 1990). The dimensions of the spores of *T. parasitica* (3.5-7.0 μm) (Johnson and Sparrow, 1961) are in good agreement with the present observations.

The above considerations allow to attribute the observed fungal parasite of *H. stipulacea* to the genus *Tetramyxa*. Its identity with *T. parasitica* would represent a new host record for this species. However, the low frequency of tetrads, just 11%, and the high proportion of single spores cast some doubts, although the tetrads might have dissociated in material stored for a long time. The formation of biflagellate zoospores cannot discriminate between *Tetramyxa* and *Plasmodiophora*. Although a biflagellate motile stage is typical of *Plasmodiophora*, *Tetramyxa* is the sole genus of Plasmodiophoraceae in which zoosporangia and zoospores have not yet been observed with certainty, as emphasized by Karling (1968). Maire and Tison (1911) observed numerous zoospores, oval in shape and with a unique long flagellum, in brackish water inoculated with quiescent spores of *T. parasitica*; these were obtained from swellings of plants of *Ruppia rostellata* Koch, but the authors were not sure about the actual origin of the observed zoospores. Evidently it was a mistake since a fungus with uniflagellate zoospores cannot belong to the Plasmodiophorales. Cook (1933) observed the release of amoeboid cells from resting spores of *T. parasitica*. According to Karling (1968), the finding of biflagellate zoospores in *Tetramyxa* would be just a matter of time; so the present observation would prove him right.

The hosts so far reported for *T. parasitica* are monocots from fresh- or brackish water, taxonomically close to the Hydrocharitaceae, to which *Halophila* is assigned; however, *H. stipulacea* is a species growing definitely in seawater.

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THE NORTH AMERICAN TRUFFLING SOCIETY: INTRODUCTION TO ITS SERIES ON TRUFFLES AND TRUFFLE-LIKE FUNGI

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ABSTRACT

The North American Truffling Society (NATS), founded in 1978, has members across North America as well as on other continents. It conducts a continuing program on truffles and truffle-like fungi: forays, scientific studies, education, and culinary use. Taxonomic and ecological data on the more than 4,500 collections by members are entered into a data base available to scientists studying these fungi. This paper introduces the NATS series on descriptions of new taxa and presentation of new data on previously described taxa.

The North American Truffling Society, Inc. (NATS) is a specialized scientific and educational, nonprofit organization. It was founded at Corvallis, Oregon, in 1978 by Anthony B. Walters and a small group of others interested in study and use of truffles and truffle-like fungi (hereafter referred to as "truffles"). Dr. James Trappe has served as scientific advisor from its inception.

NATS has grown from an initial few to over 300 members across the United States and Canada and has members in several other countries as well. Its purpose is to enhance scientific knowledge of North American truffles and to promote appreciation and enjoyment of these interesting and often beautiful fungi. Scientific activities include determining methods for finding truffles; collecting specimens; recording data on locations, mycorrhizal host associations, and seasonality; identification and classification; determining edibility and other properties; and maintaining and expanding a library on truffles and a computer data-base on collections. The data base is available to members and scientists studying truffles and truffle-like fungi. Much of the present knowledge of the edible qualities of North American truffles results from experimentation by NATS members.

NATS works closely with professional mycologists such as Trappe and Dr. Nancy S. Weber at Oregon State University and Dr. Michael Castellano of the U. S. Forest Service, Pacific Northwest Research Station, Forestry Sciences Laboratory, Corvallis. These scientists receive all NATS collections

for identification and use in experiments. Truffle collections by NATS members have been crucial to a variety of scientific studies (*e.g.*, Castellano *et al.* 1985; Castellano and Trappe 1986; Molina *et al.* 1992; Trappe and Castellano 1986, 1991). Species ecology, use of truffle spores for mycorrhizal inoculation of tree seedlings in nurseries, host specificity phenomena of mycorrhizal fungi, and use of truffles as food by small mammals are all better known as a result. Aromatic compounds produced by NATS-collected specimens have been identified by gas chromatography and the culinary attractiveness of several species has been evaluated (Marin 1985, Marin *et al.* 1987, Marin and McDaniel 1987). NATS collections provided crucial data on fungi for use by the Forest Ecosystem Management Assessment Team appointed by President Clinton in 1993 to resolve issues related to timber management in the Pacific Northwest (Holthausen, *et al.* 1994).

NATS collections now number more than 4,500, including 65 genera and 300 species. Collections of new or rare taxa and representative collections of more common taxa are accessioned into the Mycological Herbarium, Department of Botany, Oregon State University. Field data are recorded for individual collections and entered into the data base. These data include overstory tree species, understory plant species, air temperature, soil moisture status, soil type and conditions, slope gradient and direction, microhabitat or specific conditions in which the fungi are found, date, general location, specific location, elevation, notes on fresh characters, and collector's name. When NATS was first organized, members knew little of the where, when or how to find truffles. As its studies progressed in Oregon, the ability to predict the season and location for fruiting of individual species has notably increased.

Surprises emerge as NATS members collect in unusual habitats or under environmental conditions for which conventional wisdom indicates no truffles will be found. Many new species have been unearthed as a result. Habitats that have been previously well explored also yield new taxa, due perhaps to their rarity or sporadic fruiting patterns. So far, about 100 probable new taxa have been discovered. These will be featured in a series of papers, the first of which follow this introduction under the title *NATS truffles and truffle-like fungi*. The series will also provide updated descriptions and ecological data on previously described taxa.

Education is another major activity of NATS. Monthly meetings feature speakers on a variety of mycological or botanical topics. Forays are organized each month to varied habitats, from the wet Pacific coastal forests to deserts east of the Cascade Mountains. Though most forays have been in Oregon where the largest membership occurs, many localities in Washington State and northern California have also been explored. Members in other areas are encouraged to organize "mini-forays" to explore additional habitats and introduce other people to truffles.

NATS participates in many mycological shows and exhibits, usually providing a mock forest scene to show where and how truffles grow. NATS speakers present slide shows and talks to interested public organizations and schools. A slide show with a script, available to interested organizations, introduces truffles, how they are gathered and how they look.

The NATS library focuses on truffles and related information. Library materials are circulated to members on request. Members receive a bimonthly newsletter featuring current news about the society and its members, reports of collections, and other mycological items of interest.

The *Cookbook of North American Truffles* (Evans and Evans 1987) published by NATS is still available. This volume includes general information on hunting truffles and their culinary use. All recipes were developed by NATS members. The more desirable North American species include all *Tuber* spp., but especially *T. gibbosum* Harkn. (the Oregon white truffle, so-called for its culinary resemblance to *T. magnatum*, the Italian white truffle), *Picoa carthusiana* Tul. & Tul, *Melanogaster* spp., and *Geopora cooperi* Harkn. These have distinctive flavors and pungent aromas and are used as flavorings. Many others with less distinctive aromas, such as *Rhizopogon*, *Hysterangium* and *Hymenogaster* spp., are used to add interesting texture to food.

Instructions on how "to truffle," record data on the field data cards, and submit collections for identification are provided to all new members. Those who submit collections may enclose self-addressed post cards to be informed of the identity of their specimens. All finds are published in the newsletter. Many truffle "look-alike" objects are submitted by experienced as well as new truffleers for microscopic scrutiny. Insect egg sacs, moldy fecal pellets, weathered chewing gum, rotten chunks of wood, and parasitized mushroom buttons have found their way to the laboratory for identification. Almost all NATS members, including the professional mycologists, have been fooled at one time or another.

NATS presently has members in 28 states, 3 provinces of Canada, Mexico, and several countries outside North America. Newsletters are exchanged with 36 mycological societies. Members come from all walks of life, ranging from tree farmers, mill workers, teachers and dentists to professional mycologists. All share a common interest in these fascinating fungi and a desire to expand knowledge about them. Further information about NATS and membership is available by telephone (503) 752-2243 or (503) 537-0608 or mail (P. O. Box 296, Corvallis, OR 97339-0296).

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NATS TRUFFLE AND TRUFFLE-LIKE FUNGI 2: *KJELDSENIA AUREISPORA* GEN. ET SP. NOV., A TRUFFLE-LIKE FUNGUS IN THE CORTINARIACEAE

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ABSTRACT

An unusual fungus showing distinct ties to the Cortinariaceae was found in Mendocino County, California. This fungus has a white peridium, staining first yellow then reddish brown upon handling. The brown gleba has locules which radiate asymmetrically from a central, reduced columella. It resembles no other described genus and is described here as *Kjeldsenia aureispora* gen. et sp. nov.

METHODS

Colors of fresh specimens are in general terms of the authors. Specimens were field-dried with a forced air dehydrator at 49°C (120°F). Microscopic characters were determined from hand sections mounted in 5% KOH, Melzer's reagent, or cotton blue, as indicated. Spore dimensions are based on at least 50 randomly selected spores and do not include ornamentation or hilar appendage. Light photomicrograph from section mounted in 5% KOH. Herbarium names are abbreviated according to Holmgren et al. (1990).

TAXONOMY

Kjeldsenia aureispora Colgan, Castellano & Bougher, gen. et sp. nov.

Basidiomata hypogaea, subglobosa vel irregularia, 0.4-2.0 cm in diam., carnosa vel elastica, leviter pubescentia, alba, lutescentia; rhizomorphae

absentes. Gleba atrobrunnea, loculis vacuis, ab columella radiantibus. Peridium 50-400 µm crassum, hyphis hyalinis, intertextis 4-10 µm in diam. Trama hyphis hyalinis, intertextis 3-10 µm in diam; fibulae infrequentes. Basidia in hymenio, 4-spora, 40-55 x 5-8 µm, hyalina; sterigmata hyalina, 0.5 x 1.5 µm. Sporae ellipsoideae, pro parte maxime symmetricae, 7.5-10.5 x (4-) 4.5-5.5 µm, in massa brunnea, verrucis irregulariter rotundatis, brunneis; rostrum rotundatum, ornatum; episporium luteolum, inconspicuum.

Basidiomata subglobose to irregular 0.4-2cm in diameter, slightly pubescent, white, quickly turning yellow upon handling, darkening reddish brown overnight; rhizomorphs absent. Texture fleshy to rubbery, taste and odor not recorded; hard when dried. **Gleba** brown to dark brown, locules empty, radiating asymmetrically from central, reduced columella. **Peridium** 50-400 µm thick, comprised of a single layer of hyaline to pale yellow, compactly arranged, branching, interwoven hyphae, 4-10 µm in diam, somewhat gelatinized. **Trama** of hyaline, interwoven, branched hyphae, 3-10 µm in diam; clamp connections infrequent. **Basidia** 4-spored; 40-55 x 5-8 µm, hyaline, cylindrical, sinuous, tightly packed together forming a distinct hymenium; sterigmata hyaline, 0.5 µm x 1.5 µm, cylindrical.

Spores statismosporic, ellipsoid in face and side view, mostly symmetric, a few slightly asymmetric, 7.5-10.5 x (4-) 4.5-5.5 µm excluding hilar appendage; singly golden in KOH and Melzer's reagent, walls strongly cyanophilic. **Ornamentation** of irregularly shaped warts ≤ 1 µm tall, slightly darker in color than the spore wall, also cyanophilic; hilar appendage, hyaline pale yellow to pale brown, up to 4 µm long; spore wall ± 1 µm thick. **Episporium** pale yellow, inconspicuous, adhering closely to spore wall and in between the ornaments.

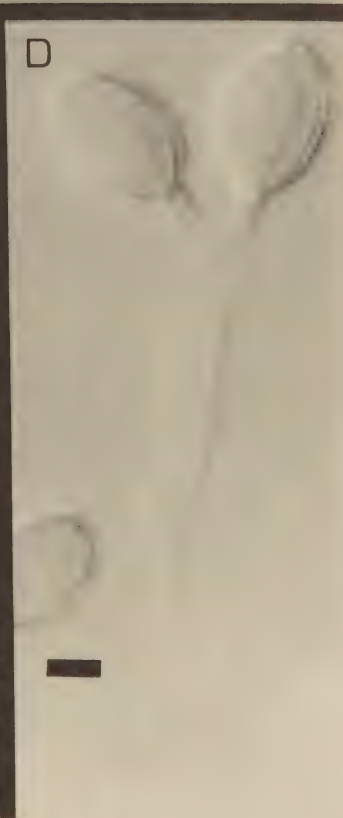
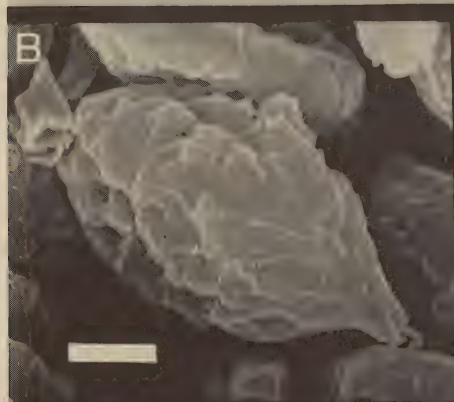
Etymology: "*Kjeldsenia*" in honor of Dr. C.K. Kjeldsen, professor of Botany at Sonoma State University, Rohnert Park, California. Dr. Kjeldsen inspired the senior author and many others to pursue careers in mycology; *aureispora* refers to the spore color in transmitted light.

Collection examined: California: Mendocino Co., Hwy. #20, mile post 12.65, 10 meters off south side of highway, Lat. N39° 21', Long. W 123° 40', 11 April 1991, M. Castellano, *Trappe #11746* (Holotype OSC, Isotype PERTH).

Habit, Habitat: Hypogeous; found at 500 ft elevation in a mixed stand of *Abies grandis* (Dougl. ex D. Don) Lindl., *Lithocarpus densiflora* (H. & A.) Rehd., and *Pseudotsuga menziesii* (Mirb.) Franco.

Discussion: *Kjeldsenia* macroscopically resembles *Sclerogaster* Hesse (Fogel 1977) but differs in peridial structure, locule, and spore characters.

Fig. 1. *Kjeldsenia aureispora* Fig. 1A. Sporocarps in cross-section (left) showing gleba and remnant columella and external surface (right), bar=1cm. Fig. 1B, 1C: SEM photomicrograph of basidiospores, bar = 2µm. Fig. 1D. Light photomicrograph of basidia and basidiospores (Nomarski optics), bar = 5µm.



Sclerogaster is not a member of the Cortinariaceae and has filled locules and globose, hyaline spores. The ornamentation, color and shape of *Kjeldsenia* spores show affinity to the Cortinariaceae. Within the Cortinariaceae, *Kjeldsenia* shows alignment with *Hymenogaster sensu* Bougher and Castellano (1993), and *Destuntzia* Fogel and Trappe (1985). *Kjeldsenia* differs from *Hymenogaster* by possession of thin-walled, ellipsoid spores lacking a cup-like hilar appendage. *Kjeldsenia* spores lack the thick, complex spore wall found in *Cortinomyces*. *Kjeldsenia* locules are empty and lined with a hymenium in contrast to the jell-filled locules and disorganized hymenium of *Destuntzia*.

ACKNOWLEDGMENTS

We appreciate Dr. J.M. Trappe for providing the Latin diagnosis and reviewing this manuscript. We appreciate Dr. Ross Beever for reviewing this manuscript.

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NATS TRUFFLE AND TRUFFLE-LIKE FUNGI 3: *GASTROBOLETUS DINOFFII* SP. NOV.

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ABSTRACT

A new species of truffle-like Basidiomycotina related to the Boletaceae, *Gastroboletus dinoffii*, is described from San Bernardino Co. in the San Jacinto mountains of California.

INTRODUCTION

Thiers (1989) realigned *Gastroboletus* along phylogenetic lines and coined the genera *Gastrosuillus* and *Gastroleccinum* to accommodate *Gastroboletus* species that had morphological affinities with *Suillus* and *Leccinum*, respectively. Thiers (1989) also divided *Gastroboletus* into two sections, *Gastrosuillamentosi* aligned with *Boletus* section *Subtomentosi* and *Gastroboletelloides* with affinities to *Boletellus*. Cazarés and Trappe (1991) recombined *Truncocolumella rubra* Zeller as *Gastroboletus ruber* (Zeller) Cazarés & Trappe (1989) based on sporocarp macromorphology and the presence of ballistospores. *Gastroboletus dinoffii* resembles *G. ruber* in having a sporocarp macromorphology intermediate between *Truncocolumella* and *Gastroboletus*.

METHODS

Methods of collection and macroscopic and microscopic study were generally those of Castellano et al. (1989). Herbarium names are abbreviated according to Holmgren et al. (1990). Colors of fresh specimens are in general terms. Hand-cut sections of both fresh and dried material were mounted in 5% KOH or Melzer's reagent for standard light microscopy. Dried spores were mounted on peps with double-sided tape and coated with gold for electron

microscopy using an Amray 3000 scanning electron microscope. Spore dimensions are based on the measurement of 30 randomly selected spores mounted in KOH; spore lengths include sterigmal attachment. Measurements of sterile tissues (e.g., peridium) and spores are from mature sporocarps. Light photomicrographs are from material mounted in 5% KOH.

TAXONOMY

Gastroboleus dinoffii Nouhra & Castellano sp. nov.

Basidiomata usque ad 6 x 4.5 cm., irregularia, subglobosa vel turbinata, peridio persistenti omnino inclusa, rimosa vel squamosa, pagina supera obscure griseo-brunnea, basis sanguinea. Gleba gelatinosa, olivacea, loculis vacuis, tubulosis, basi radiantibus. Columella non percurrans, dactyloidea; contextu luteis, celeriter cyanescenti. Peridium 200-300 μ m crassum. Trama 20-30 μ m crassa, in solutione Melzeri purpurea. Basidia clavata, 18-20 x 6-7 μ m, 1-2-spora. Sporae laeves, fusiformes, asymmetricae, 7-17.5 x 6-7 μ m, in KOH citrinae. Holotypus Trappe # 8233 (OSC).

Basidiomata up to 4.5 cm wide x 6 cm tall, irregular, subglobose to turbinate with a basal projection, completely enclosed by a persistent peridium, surface rimose to having large appressed scales, deep red on underside and in cracks, dull grayish brown on top. **Gleba** gelatinized, olive; locules empty, tubulose, intervenose and cross-walled, radiating from base. **Columella** arising from a broad sterile base that tapers to a basal attachment, irregularly projecting into gleba but not percurrent, all the edges near the gleba dark red, edges and fingers of the columella further inside gleba with yellow context that turns blue quickly when exposed, pale yellowish brown when dried.

Rhizomorphs absent. **Odor** not distinct. **Taste** not determined.

Peridium 200-300 μ m thick, a single layer of thin-walled, hyaline, loosely interwoven hyphae 3-4 μ m in diam; clamp connections absent.

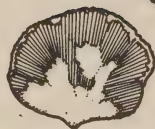
Trama 20-30 μ m thick, of thin-walled, hyaline in KOH, parallel to subparallel hyphae 3-5 μ m in diam, mediocratum is purple (amyloid) in Melzer's reagent; clamp connections common. **Basidia** clavate, thin-walled, hyaline, 18-20 x 6-7 μ m, 1-2-spored; sterigmata 1.5-3.0 μ m tall, tapered, hyaline; basidioles abundant, hyaline, thin-walled, irregularly shaped, up to 40 μ m tall. **Subhymenium** of 2 or 3 layers of thin-walled, hyaline to diffusely purple (amyloid), inflated globose cells, 7-15 μ m in diam.

Spores smooth, fusiform, 7-17.5 x 6-7 (-7.5) μ m, (mean 13.0 x 5.9 μ m), 11-26 (-30) x 5-7 when attached to basidia, length:width ratio ((1.5-) 1.9-3, mean = 2.3); walls $\pm$ 1 μ m in diam; apex acute, apiculus conspicuous, hyaline, 1

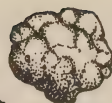
Figs. 1-7. *Gastroboletus dinoffii*. 1. Sporocarps transection; p: peridium, g: gleba, sb: sterile base. 2. Sporocarp surface view. 3. Basidia and basidioles. 4. Tramal hyphae with clamp connections. 5. Peridial structure with oleiferous hyphae. 6. Sterile base and columella structure. 7. Hymenium and subhymenium showing immature (in) and mature (ma) spores. Scales 1 cm for 1 & 2; 10 μ m for 5; 50 μ m for 3, 4, 6 & 7.



1



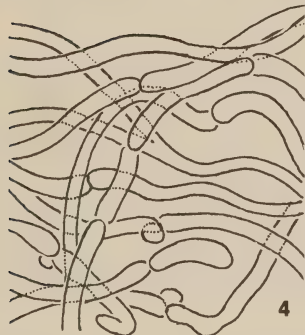
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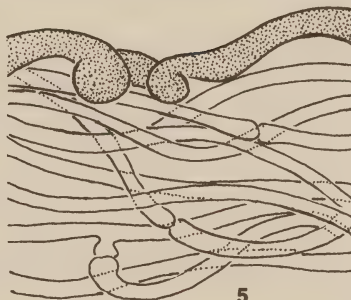
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10 μ m

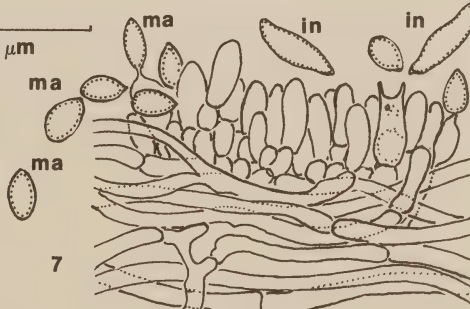
4



5



6

50 μ m

7

µm long ; most if not all spores asymmetrical; in KOH strong yellow singly, deep orange in mass, nonreactive in Melzer's reagent.

Etymology: "*dinoffii*" named in honor of Travis Dinoff, member of the North American Truffling Society (NATS) and collector of the holotype.

Habit, Habitat: Hypogeous under *Pinus jeffreyi* ; 2200 m elevation.

Collection examined: California, San Bernardino Co., San Jacinto Mountains, Black Mtn. campground, 28 Oct. 1984, T. Dinoff, *Trappe #8233* (Holotype OSC).

Discussion: *Gastroboletus dinoffii* and *G. ruber* are intermediate between *Gastroboletus* and *Truncocolumella*. The stipe-columella of both is more reduced than in other *Gastroboletus* species and rarely, if ever, percurrent. The spores of *G. dinoffii* are similar in size and shape to *G. ruber* and ballistosporic, and the context of the columella of both quickly turns blue upon exposure. The locules of *G. dinoffii* are tubulose and radially arranged but more or less completely enclosed by peridium, while in *G. ruber* the peridium is found as a remnant at the apex of the sporocarp. The amyloid trama sets *G. dinoffii* apart from all other *Gastroboletus* species except *G. amyloideus* (Thiers 1989). *Gastroboletus amyloideus* has amyloid spores and a distinct stipe (Thiers 1975) both of which are lacking in *G. dinoffii*.

Gastroboletus dinoffii belongs in section *Gastrosuhtomentosi* based on the red overtones to the sporocarp, dry peridial surface and structure of the peridium (Thiers 1989). *Boletus calopus* Fries also has amyloid tramal hyphae, blue bruising reaction of the context and spore size and shape. *Boletus calopus* resides in section *Boletus*, subsection *Calopodes* characterized by yellow tubes when young, a bitter taste to the flesh and a finely reticulate stipe (Smith & Thiers 1971).

ACKNOWLEDGMENTS

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NATS TRUFFLE AND TRUFFLE-LIKE FUNGI 4: *AMOGASTER VIRIDIGLEBA* GEN. ET SP. NOV., A NEW TRUFFLE-LIKE FUNGUS FROM THE SIERRA NEVADA

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ABSTRACT

A new genus and species of truffle-like Basidiomycotina, *Amogaster viridigleba*, possibly related to the Gyrodontaceae, is described from Sierra County in the Sierra Nevada of California.

INTRODUCTION

The diverse ectomycorrhizal host species in northern California are accompanied by abundant and diverse ectomycorrhizal fungi. This richness of both plant and fungal flora relates to the vast array of habitats of this region of the western United States. In the Sierra Nevada mountains a species of truffle-like Basidiomycotina was encountered that defied placement in known genera. This species macroscopically resembles *Rhizopogon* spp. but has distinctive microscopic characters.

METHODS

Methods of collection and macroscopic and microscopic study were generally those of Castellano et al. (1989). Herbarium names are abbreviated according to Holmgren et al. (1990). Colors of fresh specimens are in general terms. Hand-cut sections of both fresh and dried material were mounted in 5% KOH or Melzer's reagent for light microscopy. Dried spores were mounted on pegs with double-sided tape and coated with gold for electron microscopy using an Amray 3000 scanning electron microscope. Spore dimensions are based on the measurement of 30 randomly selected spores; spore lengths include sterigmal attachment. Measurements of sterile tissues (e.g., peridium) and spores are from mature sporocarps. Light photomicrographs are from material mounted in 5% KOH.

TAXONOMY

Amogaster viridigleba Castellano gen. et sp. nov.

Basidiomata usque ad 1.25 x .75 cm., subglobosa vel irregularia, alba vel viridula e gleba subter peridio. *Peridium* 20-30 μm crassum, evanescens, aurantium vel roseum ubi contusum, subtiliter tomentosum, hyphis hyalinis vel brunneolis, 1-2 μm in diam. *Gleba* viridula, loculis rotundis vel irregularibus, vacuis. *Trama* 20 - 50 μm crassa, hyphis hyalinis, 1-2 μm in diam. *Rhizomorphae* destitutae. *Columella* parva, cartilaginea, dendroidea. *Basidia* clavata, 10 - 15 x 4 - 6 μm , sporis quatuor. *Sporae* laeves, 9-14 (-15) x 4-6 μm , ellipsoideae, subglobosae vel subfusiformes, saepe asymmetricae, in KOH pallide avellaneae, in solutione Melzeri rubrae vel cinnamomeae. *Odor* indistinctus.

Basidiomata up to 1.25 x 0.75 cm, subglobose to irregular, white or pale green from underlying gleba when fresh; peridium thin, evanescent, bruising orange to pale red, finely tomentose. **Gleba** pale green when fresh, pale to medium yellow when dried, with round to irregular, empty locules.

Rhizomorphs absent. **Columella** small, cartilaginous, dendroid when fresh, inconspicuous when dried. **Odor** not distinct. **Taste** not determined.

Peridium 20-30 μm thick, a single layer of thin-walled, hyaline to pale brown, loosely interwoven to subpericlinial hyphae 1-2 μm in diam; clamp connections absent.

Trama 20-50 μm thick, of thin-walled, hyaline, interwoven hyphae, 1-2 μm in diam occasionally inflated to 6 μm ; clamp connections absent. **Basidia** clavate, hyaline, 10-15 x 4-6 μm , wall thickness 0.5 μm , 4-spored; sterigmata 5 x 1 μm , tapered, hyaline.

Spores smooth, 9-14 (-15) x 4-6 μm , (mean 11.6 x 5.1 μm), length:width ratio (1.8-) 2.2-2.6 (-3.0), ellipsoid, subglobose or subfusiform; apex blunt, base with sterigmal attachment; most if not all spores asymmetrical; in KOH pale yellow brown singly, yellow brown in mass, in Melzer's reagent some dextrinoid (deep red) others orange brown singly.

Etymology: "*Amogaster*" named in honor of Dr. Michael P. "Amo" Amaranthus, consummate truffle and collector of the holotype, "*viridigleba*" in reference to its green gleba.

Habit, Habitat: Hypogeous in soil under *Populus* spp.

Collection examined: California, Sierra County, San Francisco State University Biology Field Campus, 13 June 1987, M. Amaranthus, *Trappe* #9493 (Holotype OSC, lostype SFSU).

Figs. 1-3. Basidiospores of *Amogaster viridigleba*, Trappe 9493. 1. bar = 11 μm . 2. bar = 5 μm . 3. bar = 1 μm .



Discussion: *Amogaster* macroscopically resembles *Rhizopogon*, which is derived from *Suillus* judging from the similarity of its spores and other microscopic characters as well as molecular data (Bruns et al. 1989).

Amogaster differs from *Rhizopogon* and thus *Suillus* most critically in its spore characters, having larger, asymmetrical spores that are sometimes dextrinoid and in the color of its gleba which lacks any hint of olive or brown. Based on these characters and the association of *Amogaster* with *Populus* spp. a phylogenetic relationship with the genus *Gyroporus* or *Paragyrodon* should be explored through molecular techniques. *Gyroporus* and *Paragyrodon* have clamp connections, *Amogaster* lacks clamp connections.

A mycorrhizal association of *Amogaster* and *Populus* is inferred due to the close association of sporocarps with mycorrhizal roots in the field. Further experimental work is necessary in the laboratory for confirmation. Pure cultures of *Amogaster viridigleba* made from fresh sporocarps in the field are available from this laboratory.

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DESCRIPTION AND PHYSIOLOGICAL PROPERTIES OF TWO NEW VARIETIES AND ONE SPECIES OF *MICROASCUS* FROM ISRAEL.

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ABSTRACT

A taxonomic description of 4 taxa of *Microascus* isolated from soil in Negev (Israel) is provided. Among them, one may be considered as a new taxon: *Microascus dimonatus* Sage sp.nov., and two seemed to be varieties of known species: *M. desmosporus* var. *macroperithecia* Sage var. nov., *M. trigonosporus* var. *macroperithecia* Sage var. nov.. The last strain isolated appeared to be only a variant of *M. desmosporus* var. *macroperithecia*. The main cultural characteristics and physiological properties of these species are described.

INTRODUCTION

During the course of determination of the fungal population in soil samples from Negev (Israel), atypical *Microascus* species were isolated. These species were not described in reviews concerning the genus *Microascus* (Barron et al. 1961; Morton & Smith 1963; Skou 1973; Von Arx 1975, 1978; Horie & Udagawa 1983; Malloch & Hubart 1987;). They were not reported in previous papers dealing with mycoflora of this area (Rayss 1950; Rayss & Borut 1958; Borut 1960; Abdel-Hafez 1982a,b).

Our purpose was to describe these new taxa and to give their main physiological properties. Organic extracts from the culture medium of some of these strains showed an inhibitory activity against pathogenic microorganisms.

MATERIALS AND METHODS

Strain isolation. Soil sample (sand) was collected in Negev (Israel), in the area of Dimona. Isolation of the strains was accomplished by using the soil plates method of Warcup (Parkinson & Waid 1960): the soil sample was dispatched into Petri dishes (90 mm diameter) and sterile malt extract (1.5%)-agar (1.5%) (MEA)-chloramphenicol (0.05%) or potato dextrose agar (PDA)-chloramphenicol media were poured over. After solidification, dishes were incubated at 22°C and strains were isolated as soon as they appeared. The four seemingly new species were designed by *Microascus* 1, 2, 3, 4.

Soluble salts level determination. 1 g of dry soil was suspended in 5 ml of distilled water by vigorous shaking. After centrifugation (5 min. at 3000 g) and/or filtration, pH of the supernatant was measured and ionogram (Na^+ , K^+ , Cl^- , Ca^{2+} , Mg^{2+}) was established with an automated analyzer BM/Hitachi 717 (Boehringer Mannheim, France) using the methods adapted by Boehringer Mannheim. Results were expressed as $\mu\text{mol/g}$ of dry soil.

Influence of temperature and pH. The strains were grown on MEA and PDA at the usual pH of these media (5.5 for MEA and 6.2 for PDA) and at pH 7 and 8. Incubation run at 4, 22, 30, 37°C for 36 days. Growth was followed by measuring the diameter of colonies.

Enzyme assays. The methods used for the detection of lipase, protease and amylase production have been described by Hankin & Anagnostakis (1975). Cellulases were detected according to Smith (1977); the same method was adapted to the detection of amylolytic activity according to Rinderknecht et al. (1967). Results of these assays were only qualitative. Extracellular phenoloxidases (POx) production was researched on PDA (*Microascus* 1, 2, 3) or on MEA (*Microascus* 4) at 22°C as previously described (Guiraud et al. 1992). Ten reagents were used and following their intensity, the colored reactions observed were noted from 0 to 4. Results were given as a POx index corresponding to the sum of the different reactions obtained. These assays were performed with 10 to 15 day-old cultures.

Antimicrobial activity. The strains were grown in different liquid media. For antibacterial and anti-human pathogens assays, the fungus (mycelium + spores) was inoculated in 250 ml Erlenmeyer flasks, containing 70 ml of liquid PDA (*Microascus* 1, 2, 3) or MEA (*Microascus* 4) medium and grown under shaking or static conditions at 22°C for 8 days. For anti-phytopathogens and anti-entomopathogens assays, cultures run in yeast extract (2%)-saccharose (4%) pH 6.5 medium, under static conditions for 5 days

(previous experiments showed that these conditions allowed optimal activity)(Pujol et al. 1990). Media were separated from the mycelia by filtration and extracted by 2x35 ml ethyl acetate. Organic phases were pooled and dried at 40°C under reduced pressure. Crude extracts were dissolved in 3 ml ethyl acetate. Target pathogenic strains were 5 bacteria (*Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* penicillin resistant, *S. aureus* penicillin sensitive, *Streptococcus faecalis*), 7 yeasts (*Candida albicans*, *C. glabrata*, *C. parapsilosis*, *C. tropicalis*, *C. tropicalis* amphotericin resistant, *Cryptococcus neoformans* 1, *C. neoformans* 2), 8 Dermatophytes (*Epidermophyton floccosum*, *Microsporum canis*, *M. gypseum*, *Trichophyton mentagrophytes* 1, *T. mentagrophytes* 2, *T. mentagrophytes* var. *interdigitale*, *T. rubrum*, *T. tonsurans*), 5 phytopathogens (*Colletotrichum musae*, *Drechslera spicifera*, *Fusarium oxysporum*, *Geotrichum candidum*, *Pyricularia oryzae*), 4 entomopathogens (*Beauveria bassiana*, *B. brongniartii*, *Metarrhizium anisopliae*, *Verticillium lecanii*). Assessment of antimicrobial activity of crude extracts was performed using the disk diffusion method previously described (Okeke et al. 1992).

Polysaccharide production. Presence of extracellular polysaccharide in culture medium was researched in shaken liquid PDA (*Microascus* 1, 2, 3) or MEA (*Microascus* 4) medium at 22°C according to Aouadi et al. (1992).

All assays were repeated four times.

RESULTS AND DISCUSSION

Seven taxa of *Microascus* were isolated from the same soil sample. Four of them were atypical and are the object of a description in this paper. Table 1 summarizes the main characteristics concerning *Microascus desmosporus* (Lehmer) Curzi, *Microascus pyramidus* Barron & Gilman, *Microascus trigonosporus* Emmons & Dodge, *Microascus trigonosporus* var. *macrosporus* Orr, which were found to be the most closely related species (Barron et al. 1961; Morton & Smith 1963). The three new varieties and the new species have been included in the culture collection of the laboratory: Collection Mycologie Pharmacie Grenoble (CMPG) and sent to the American Type Culture Collection (ATCC). Moreover, all holotypes are preserved specimens.

Microascus 1

Microascus desmosporus var. *macroperithecia* var. nov. Sage, Steiman, Seigle-Murandi & Guiraud.

TABLE 1
MAIN CHARACTERISTICS OF FOUR MICROASCUS SPECIES CLOSELY RELATED TO THE NEWLY ISOLATED
STRAINS (DIMENSIONS ARE IN μm) (BARRON et al. 1961; MORTON & SMITH 1963)

	<i>M. trigonosporus</i>		<i>M. trigonosporus</i> var. <i>macrosporus</i>		<i>M. desmosporus</i>		<i>M. pyramidus</i>	
	Morton	Barron	Barron	Morton	Barron	Barron	Barron	Barron
Perithecia	150-200	125-250	125-250	80-200	160-200	125-250		
Neck	up to 75	up to 250	up to 50	up to 250	nd	100-200		
Asci	10-11x7-8	9-12x 6-9	10-13x5-8	9x12	13-14x 6-7	13-18x 9-12		
Ascospores	Triangular 4-5x3.5-4	Triangular 3.5-5.5x 2.5-3.5	Triangular 5.5-7.5x5-6.5	Triangular reniform lunate 5-6x3-5	Ovoid	Triangular tetragonal		
Conidia	4-4.5x3-4	3.5-5.5x 2.5-3.5	5-7x4-5	4-6x3.5-5	3.5-4.5x 2.5-3.5	5.5-7x 5-6.5	4.5-5.5x 3-4	

nd: not described.

Coloniae in agar - solanum tuberosum - saccharon dicto 24°C post 7 dies 12-15 mm diametrum, primum griseae pallens, deinde subnigrae.

Peritheciis membranaceis, sphaericis albis, superficie mycelii enatis, laevibus pilisve simplicibus valde irregulariter dispositis ornatis; collum usque 60 µm; ostiolo apicali praeditis; ascis, paraphysibus non immixtis, membrana tenuissima maturescenti-dilabente tunicatis; ascis octosporis, subglobois 10 µm vel ovatis 12-14 x 8.5-10 µm; ascosporis octonis, griseis, utraque fine leniter aculeatis 5-6 x 3.5-5 µm; conidiis oidiisve secundum varietatem.

Mycelium e hyphis hyalinis vel pigmentatis; annelides aliquando solitariae; conidia ovata, cum basi truncata, 5 x 3.5-4 µm; aleuriospora solitaria, globosa 4 µm diam.; chlamydospora brunnea.

Typus : peritheciis 160-200 µm diam. longas ascosporarum catenas emittentibus. - Var. *macroperithecia* : peritheciis 245-325 µm.

Holotypus: ex terra proxime ab Dimona, Negev, Israel, 1992; in collectione fungorum (CMPG et ATCC) deposita est.

Colonies on PDA at 24°C 12-15 mm in 7 days, 45 mm after 6 weeks, at first mouse-grey, becoming dark grey, centrally umbonate. Reverse dark brown or blackish, perithecia mostly below the aerial mycelium. Conidial stage and perithecia present all over, more densely centrally. Perithecia dark, glabrous, 245-325 µm diameter, with neck up to 60 µm long. Mature asci globose about 10 µm diameter, or ovate 12-14 x 8.5-10 µm, 8-spored. Ascospores polymorphous, light greyish in mass, triangular with one side concave or reniform to lunate 5-6 x 3.5-5 µm. Conidial stage *Scopulariopsis*, mycelial hyphae light becoming dark brown, more or less funiculose. Annelophores born singly or in whorls on conidiophores, approaching a penicilloid habit. Annelospores ovate with a truncate base and rounded apex, light brown in mass, 5 x 3.5-4 µm. Chlamydospores dark brown, single or in chains, terminal or intercalary. Solitary globose aleuriospores, 4 µm diameter, formed fairly frequently along the hyphae.

Colonies on MEA 6-8 mm at 24°C in 7 days, 45 mm after 6 weeks, becoming dark olivaceous, velvety, producing conidia all over, above a semi-submerged outer zone. Reverse dark brown or black, perithecia mostly below the aerial mycelium. Cirrhi produced in about 5 weeks, very long red brown columns up to 2 mm.

This species was compared to *M. desmosporus*, initially described by Lechmere (1913) as *Peristomium desmosporum*, it exhibited both the chlamydospore form reported by Barron et al. (1961) and the aleuriospore form mentioned by Morton & Smith (1963). However, perithecia were regularly bigger attaining 325 µm diameter so the strain was considered as a new variety of *M. desmosporus*: *M. desmosporus* var. *macroperithecia* var. nov. Sage, Steiman, Seigle-Murandi & Guiraud (CMPG 1272).

Microascus 2

Microascus trigonosporus var. *macroperithecia* var. nov. Sage, Steiman, Seigle-Murandi & Guiraud.

Coloniae in agar - solanum tuberosum - saccharon dicto 24°C post 7 dies 25 mm diametrum, mycelium album; perithecia nigra, glabra, lente matura; collum 40 µm diam x usque 250 µm, pilosum; asci octospori, subglobosi 10 µm diam vel ovati 12-13 x 9-10 µm; ascosporiae triangulariae, 5-5.5 x 3.5-4 µm.

Mycelium e hyphis hyalinis vel pigmentatis; annelides aliquando solitariae, 7-12 x 2-4 µm; conidia ovata, cum basi truncata, 4.5-5 x 3.5-4 µm.

Typus : peritheciis 125-250 µm diam. - Var. *macroperithecia* : peritheciis 245-330 µm diam.

Holotypus: ex terra proxime ab Dimona, Negev, Israel, 1992; in collectione fungorum (CMPG et ATCC) deposita est.

Colonies on PDA 25 mm at 24°C in 7 days, over the plate in 5 weeks, reverse pale buff with brownish patches. Mycelium white. Better growth at 28°C than at 24°C with increased production of perithecia. Perithecia black, glabrous, 245-330 µm diameter, neck up to 250 µm long, cylindric, 40 µm diam., sometimes trumpet-shaped at the top with a tuft of ostiolar hairs. Asci globose, 9-10 µm diam., or ovate 12-13 x 9-10 µm, 8-spored. Ascospores triangular with all three sides concave, rounded at the ends, red brown in mass, 5-5.5 x 3.5-4 µm. Conidial stage *Scopulariopsis*, mycelial hyphae hyaline to light brown, forming funicles centrally. Annelophores born singly along the hyphae or on conidiophores, 7-12 x 2-4 µm, branched and approaching a penicilloid habit. Annelospores ovoid, 4.5-5 x 3.5-4 µm, truncate at the basal end, papillate at the apical end.

Colonies on MEA 8-10 mm at 24°C in 7 days, 25-30 mm in 4 weeks, plate not covered after 6 weeks. Colonies azonate, irregular in outline, light grey, becoming dark when producing perithecia, reverse light grey.

This species exhibited the same ascospores than *M. trigonosporus*, but dimensions of perithecia were higher than those described for *M. trigonosporus*. Perithecial neck attained 250 µm, which is in agreement with the observations of Barron et al. (1961) while Morton & Smith (1963) described a very short neck. Since Barron et al. (1961) reported the variability of *M. trigonosporus* as a function of substrates and geographical origin, the strain was assimilated to *M. trigonosporus*. However typical *M. trigonosporus* was isolated together, suggesting that the atypical strain may be a new variety, so the name of *M. trigonosporus* var. *macroperithecia* var. nov. Sage, Steiman, Seigle-Murandi & Guiraud is proposed (CMPG 1273).

Microascus 3 (Fig. 1 a,b,c,d)

Microascus dimonatus sp. nov. Sage, Steiman, Seigle-Murandi & Guiraud.

Coloniae in agar - solanum tuberosum - saccharon dicto 24°C post 7 dies 13-15 mm diametrum, primum olivaceo-grisae cum refulgens leviter subruber nitor, deinde brunneae; perithecia abunde producentia, semi-immersa vel fere superficialia, dispersa, nigra, ad basim, 190-300 µm diam, glabra, lente matura; collum nigrum, usque 120 µm, pilosum; asci octospori, subglobosi 15 µm diam vel ovati 16-17 x 12-13 µm; ascosporiae tetragonariae vel pentagonariae, 6-6.5 x 5-5.5 µm, flavae.

Mycelium e hyphis hyalinis vel pigmentatis, annuli frequens; annelides aliquando solitariae, ad basim inflatae 8-10 µm; conidia ovata, cum basi truncata, 4.5-5 x 3-3.5 µm; aleuriospora solitaria, globosa 5 µm diam vel ovata 6 x 4 µm.

Holotypus: ex terra proxime ab Dimona, Negev, Israel, 1992; in collectione fungorum (CMFG and ATCC) deposita est.

Colonies on PDA 13-15 mm in 7 days at 24°C, olivaceous grey with vinaceous tinge, reaching a diameter of 45 mm in 4 weeks, turning brownish in age. Perithecia produced abundantly, at first in the aerial hyphae, later in and on the agar substrate even around the perimeter of the colony. Center of colonies turns to red brown with extrusion of ascospores. Perithecia superficial or immersed, globose, 190-300 µm diam., neck up to 120 µm long with a tuft of ostiolar hairs. Vinaceous brown cirrhi of ascospores appearing in very long columns after about 4 weeks. Asci subglobose, 15 µm diameter, or ovate 16-17 x 12-13 µm. Ascospores tetragonal or sometimes pentagonal in planar view, with concave sides tapering to rounded ends, golden yellow, red brown in mass, 6-6.5 x 5-5.5 µm. Conidial stage *Scopulariopsis*, vegetative hyphae often forming rings, more or less pigmented, annelophores 8-10 µm, slightly inflated at the base, born singly or in group. Annelospores ovate, slightly truncate at the base, pointed at the apex, 4.5-5 x 3-3.5 µm. Solitary aleuriospores globose, 5 µm diam., to ovate 6 x 4 µm.

Colonies on MEA 8-10 mm at 24°C in 7 days, 35-40 mm in 4 weeks, later spreading little or not all, at first centrally cottony, then producing red brown mycelium with a semi-submerged outer zone, reverse dark brown with sepia tinge.

This species was compared to *M. pyramidis*, isolated from Californian desert (USA) and described by Barron & Gilman, the sizes of sexual and conidial formations were the same for the two species. However, ascospores were quite different: tetragonal forming a shaped pyramid or pentagonal, while they are usually triangular or sometimes tetragonal in *M. pyramidis*. So this

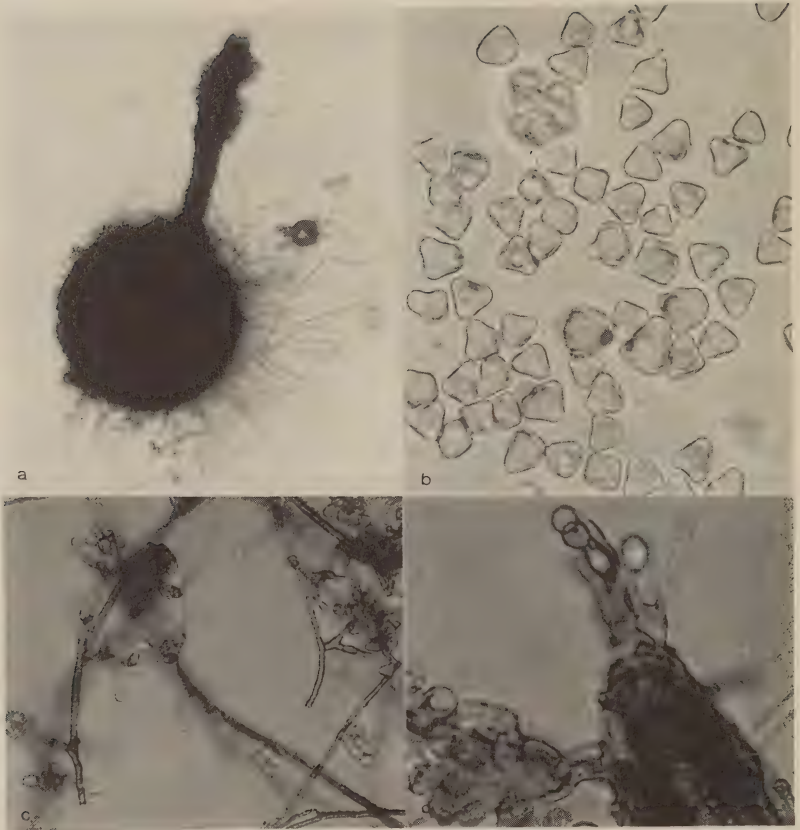


Figure 1. *Microascus dimonatus* sp. nov. a, Perithecium, 150 x; b, Ascospores, 1500 x; c, Annelophores and conidia, 600 x; d, Annelophores and conidia, 1500 x.

species was considered as a new taxon: *Microascus dimonatus* sp. nov. Sage, Steiman, Seigle-Murandi & Guiraud (CMPG 1274).

Microascus 4

Colonies on PDA 10-12 mm at 24°C in 7 days, convolute and radially furrowed, 35-40 mm in 4 weeks, never covering the plate entirely, at first white with membranous margin, perithecia poorly produced in sectors, reverse pale buff or light greyish. Perithecia formed on the surface of the medium, globose, 100-300 µm diam., mature after 6 weeks, neck absent or very short. Asci globose, 10 µm diam., or ovate 12 x 9 µm. Ascospores polymorphous, triangular, more or less allantoid or reniform, 5.5-6 x 3-4 µm, in long cirrhi columns. Conidial stage a *Scopulariopsis*, mycelial hyphae hyaline, 2-2.5 µm, annelophores born singly and sparsely along the aerial hyphae, more or less cylindrical or slightly tapered. Annelospores ovate, with more or less pointed apex and truncate base 4-5 x 2.5-3 µm.

Colonies on MEA similar to those on PDA.

This strain was very closely related to *M. desmosporus* var. *macroperithecia*, but exhibited a less abundant conidial form and a better ability to grow on malt extract as substrate. It was recorded as CMPG 1275.

It must be noticed that the 4 strains were all isolated from the same soil sample by using PDA-chloramphenicol medium. Other species of *Microascus* were isolated together with them. *Microascus nidicolus* Masee & Salmon was identified according to Morton & Smith (1963) and exhibited the property mentioned by these authors to dead when stored few days at 5°C. *Microascus desmosporus* and *M. trigonosporus* were also isolated from the same sample. Among these species, only *M. trigonosporus* was previously found during the course of survey of mycoflora in the arid countries of this part of the world. Moustafa (1975) reported *Microascus*, typical soil fungi which may be pathogenic for animals, as a moderate-occurring genus during the course of survey of osmophilous fungi in the salt marshes of Kuwait. The species isolated were *M. trigonosporus* and *M. cinereus* (Emile & Gaudo) Curzi, they were also isolated from desert soils in Saudi Arabia (Abdel-Hafez 1982a,b). *M. trigonosporus* was also reported by Rayss & Borut (1958) and found by Borut (1960) in soil samples from Mishmar Haneghev, Beersheva and Tureibe (32 km to Sdom) in Negev (Israel).

The 4 species came from a sample of soil of a desertic saline area. Soil analysis revealed a pH of 8.00, 74 µmol/g Na, 16 µmol/g

K, 77 $\mu\text{mol/g}$ Cl, 12 $\mu\text{mol/g}$ Ca and 7 $\mu\text{mol/g}$ Mg, indicating the predominance of NaCl.

Influence of culture media (MEA and PDA) and culture conditions (pH and temperature) was tested. Growth at 4°C was negative for all strains. At every other temperature, microcolonies may be observed after 2 days of incubation. The best growth for the 4 *Microascus* was obtained mostly at pH 7 and 8, at 30°C. In these conditions no great differences were observed between PDA and MEA. Growth at 37°C was good although the rate was decreased, at this temperature, growth was affected both by pH and culture medium (Fig. 2). These results indicated an adaptation of the strains to their peculiar environment.

For *Microascus* 1, 2, and 3 lot of assays were conducted with PDA medium because of their bad growth rate on MEA in 7 days.

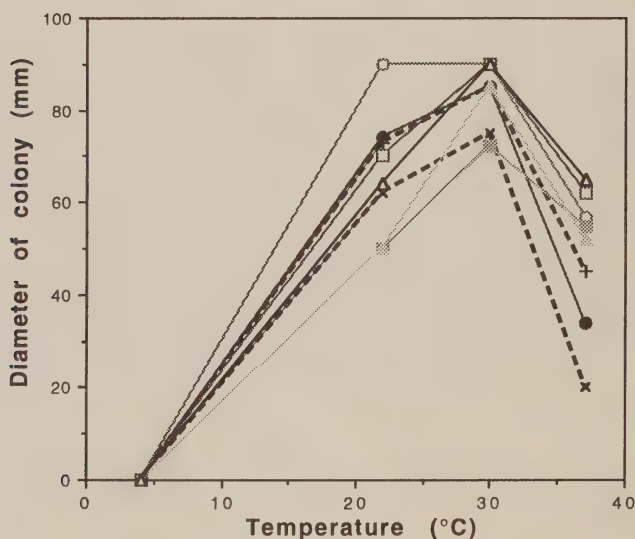


Figure 2. Growth of *Microascus* after 36 days on malt extract agar (MEA) medium, at the usual pH (5.5) and at pH 8.

M1, 2, 3, 4: *Microascus* 1, 2, 3, 4 grown at usual pH; M1, 2, 3, 4 /8: *Microascus* 1, 2, 3, 4 grown at pH 8.

---x--- M1 ---+--- M1/8 ● M2 ○ M2/8 ■ M3
 —□— M3/8 ▲ M4 ▲ M4/8

None of the 4 species was found to be cellulolytic while they all had both proteolytic and amylolytic activities. In addition, *Microascus* 1 showed also lipolytic activity. All strains exhibited a POx activity and the POx index obtained for *Microascus* 1, 2, 3 and 4 were respectively of 8, 14, 10, 17. These values corresponded to the sum of intensities of coloured reactions obtained when dropping on mycelia ten different reagents able to turn into coloured compounds if Pox are present. For each reagent, intensity of the response was noted from 0 to 4, so the maximal value for Pox index was 40 (Guiraud et al. 1992). No important intrageneric variations were observed in this case conversely to observations previously reported for other genera (Guiraud et al., 1992).

Concerning secondary metabolites, no production of polysaccharide was obtained in our experimental conditions.

Previous works in the laboratory, dealing with the research of antimicrobial products resulting from secondary metabolism in fungi have shown that the best results were commonly obtained under static liquid conditions. This general feature was not so obvious for the present species of *Microascus*.

Extracts from *Microascus* 1 and 3 were inactive against bacteria and yeasts, those from *Microascus* 2 (mostly from shaken cultures) inhibited the growth of all yeasts but were not toxic for bacteria. Conversely, extracts from *Microascus* 4 (mostly from static cultures) were inefficient against yeasts, while they inhibited all bacteria except *S. faecalis*. Extracts from culture medium of *Microascus* 1, 2, 3 were inactive against phytopathogen and entomopathogen fungi, while *Microascus* 4 showed an activity against *B. bassiana*, *B. brongniartii*, *C. musae*, *F. oxysporum*. Table 2 gives results concerning Dermatophytes. The 4 *Microascus* exhibited an activity, *Microascus* 1 showing the widest spectrum both under static or shaken conditions of culture. *Microascus* 2 was more selective but very efficient against *Microsporum canis* and *Trichophyton mentagrophytes* var. *interdigitale*.

On the whole, extracts from culture medium of *Microascus* 4 revealed the widest spectrum of activity against the various pathogenic microorganisms tested when compared with other species. Purification way and identification, as well as biological properties of antimicrobial compounds produced are under review.

In conclusion, this paper contributes to a better knowledge of both the mycoflora of Israel and the genus *Microascus*. A new species is described: *Microascus dimonatus* sp. nov.. This species, as well as new varieties of *M. desmosporus* and *M. trigonosporus*, found in the same soil sample, exhibited some interesting antimicrobial potentialities.

TABLE 2
INHIBITION OF SOME COMMON DERMATOPHYTES BY EXTRACTS OF
CULTURE MEDIA FROM 4 *MICROASCUS* SPECIES

	Ef	Mc	Mg	Tm1	Tm2	Tmi	Tr	Tt
M1S	15 (28)	9	17	12 (27)	20	9	15 (30)	0
M1A	12	10	13	14	13	0	9 (17)	0
M2S	0	30	0	0	0	20	(13)	13
M2A	8	35	0	0	0	20	(20)	16
M3A	7	0	14	7	8	0	0	0
M4S	8	10	10	8	9	0	0	0

M1: *Microascus desmosporus* var. *macroperithecia* var. nov.; M2: *M. trigonosporus* var. *macroperithecia* var. nov.; M3: *M. dimonatus* sp. nov.; M4: *M. desmosporus* var. *macroperithecia*, second strain; S: static culture; A: agitated culture; M3S and M4A gave negative results; results are inhibition diameters in mm (including a disk diameter of 6 mm); numbers under brackets indicate an area of perturbed growth; Ef: *Epidermophyton floccosum*; Mc: *Microsporum canis*; Mg: *M. gypseum*; Tm: *Trichophyton mentagrophytes* (2 strains); Tmi: *T. mentagrophytes* var. *interdigitale*; Tr: *T. rubrum*; Tt: *T. tonsurans*.

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SYSTEMATIC AND BIOLOGICAL STUDIES IN THE BALANSIEAE
AND RELATED ANAMORPHS. IX.
THE TELEOMORPH OF *BALANSIA KUNZEI*,
A NEW NAME FOR *BALANSIA EPICHLÖE*

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ABSTRACT

The development and morphology of the teleomorph, including ascostroma and perithecia, of *Balansia epichloe* (Weese) Diehl on the adaxial surface of leaves of *Eragrostis capillaris* (L.) Nees is described and illustrated. A review of the nomenclature of the fungus is made. The binomial *B. epichloe* is considered to be untenable and a new name, *Balansia kunzei* Morgan-Jones & Phelps, is proposed to replace it. Transitional stages from the primary *Ephelis* anamorph stroma to the teleomorph are traced. A revised taxonomic description is provided.

INTRODUCTION

As discussed by Diehl (1950) and Phelps *et al.* (1993) the fungus now known as *Balansia epichloe* has had quite a complicated nomenclatural history, with a number of names applied to it. The first binomial given it was *Sphaeria epichloe* Kunze. This name was published in printed labels, also bearing a brief description, attached to unnumbered specimens issued as part of C.E. von Weigelt's fungi exsiccati, named and distributed by Gustav Kunze. The material had been collected by Weigelt in Surinam. The exact date of issue is unknown and the number of sets and the extent of their distribution is not certain (Stevenson, 1971). The diagnosis provided of the fungus reads as follows: "*Sphaeria* (periph. pulvin.) *epichloe* Kz. S. (epiphylla hypogena) oblonga gemella, atra; peritheciis ovalibus, ostiolo papillato, denum pertuso. In foliis gramineae, Gujan, Surinam, leg. et exsicc. Weigelt 1827. Determ. Kunze." According to Article 31 of the ICBN, distribution of printed matter accompanying exsiccati on or after 1 January 1953 does not constitute effective publication

unless such is also distributed independently of the specimens. This does not apply before that date, however, publication being effected under Article 29 of the Code by distribution of printed matter "to the general public or at least to botanical institutions with libraries accessible to botanists generally.". The binomial *Sphaeria epichloe* Kunze was thus effectively and validly published. In this connection Stevenson (loc. cit.) makes the following pertinent comment with reference to *S. epichloe*; "Diagnosis on label, hence the name was not a *nomen nudum* as has been suggested."

Saccardo (1892) described what he believed to be the same fungus, giving it the name *Botryosphaeria* (?) *epichloe* (Kunze) Sacc. This treatment was based upon that part of the Weigelt material housed in the Jardin Botanique de l'Etat, Brussels (BR) but it is apparent that the specimen contained disparate elements and the fungus described by Saccardo was not *S. epichloe*. No asci were observed, but rather spores which were thought to be possibly conidia of a species of *Dothiorella* Sacc. The name was evidently mistakenly misapplied. Other specimens of the Weigelt exsiccati, including one housed in The National Fungus Collections (BPI), do bear the fungus currently known as *Balansia epichloe* (Diehl, 1939; 1950).

Much confusion exists surrounding use of the specific epithets '*atramentaria*' and '*atramentosa*' within the Balansieae. The binomial *Dothidea atramentaria* Berk. & Curt. (Berkeley, 1876), a *nomen nudum* and therefore not validly published, was evidently applied to *Sphaeria epichloe*, without any apparent intention of naming a new species. The epithet '*atramentaria*' is considered to have been an orthographic error for '*atramentosa*' (Diehl, 1939). The name *Dothidea atramentaria* was used for collections of *S. epichloe* issued in a number of exsiccati, including those of H.W. Ravenel [Fungi Americani Exsiccati No. 100] and J.B. Ellis [North American Fungi, No. 683]. F.K.A.E.J. de Thumen used the name *D. atramentaria* f. *eragrostidis-capillaris* Thum., for a collection of *S. epichloe*, made by Ravenel on *Eragrostis capillaris* (L.) Nees in South Carolina, and issued as No. 1068 in de Thumen's *Mycotheca universalis*. Diehl (1939) believed the host in this set of specimens to possibly be *Eragrostis refracta* (Muhl.) Scribn. and cited the material as paratype for the binomial *Dothichloe limitata* Diehl, a name proposed to replace *Sphaeria epichloe* Kunze. Atkinson (in Davis, 1929) proposed the new combination *Dothichloe atramentaria* (Berk. & Curt.) Atk. Berkeley (1869) had previously established the name *Hypocrea atramentosa* Berk. & Curt. for a fungus collected in Cuba. This was the taxon presently known as *Myriogenospora atramentosa* (Berk. & Curt.) Diehl, which Luttrell and Bacon (1977) classified among the Balansieae. Atkinson (1905) made the new combination *Dothichloe atramentosa* (Berk. & Curt.) Atk. and apparently misapplied the name to not only *B. epichloe* but also *Balansia henningiana* (Möell.) Diehl. Interestingly, Atkinson (1894) had earlier proposed the name *Myriogenospora paspali* Atk. for *M. atramentosa*, the type species of his genus *Myriogenospora* Atk. It is evident that serious misapplication of names occurred a number of times, together with much nomenclatural confusion, during the period when these fungi were first studied (Diehl, 1950; Phelps et al., 1993b). That, perhaps, is not altogether surprising since these fungi look very similar superficially and they all occur on leaves of grasses, with some host overlap.

Diehl (1939), as mentioned above, established the name *Dothichloe limitata* as an alternative binomial to replace the earlier names *Sphaeria epichloe* and *Dothidea atramentaria*. He expressed the view that it was questionable that the name used for the specimens issued in the Weigelt exsiccati had validity unless published elsewhere than on the unnumbered specimens distributed by Kunze. It was further thought that the status of *Sphaeria epichloe* had been compromised through its supposed validation by Saccardo (1892), based on incorrect identification. What Saccardo did, however, had no real relevancy to the nomenclatural status of *S. epichloe*. Because of the confusion surrounding the specific epithet '*atramentaria*', and the fact that it was published without a description or diagnosis, Diehl (1939) considered it unavailable as an alternative to '*epichloe*'. Hence the proposal to establish a new name. At the time, Diehl was unaware of the treatment of *Sphaeria epichloe* by Weese (1919), some twenty years earlier. Weese (loc. cit.) had described the fungus under the name *Dothichloe epichloe* (Kunze) Weese, a new combination. Diehl (1950) subsequently took up this name, making the new combination *Balansia epichloe* (Weese) Diehl and listing *D. limitata* as a synonym. In effect Diehl treated the binomial *Dothichloe epichloe* as if Weese had described a new species rather than reclassified *Sphaeria epichloe*. His reasoning (Diehl, 1950), in part at least, was based upon the fact that Weese had supplied what was referred to as "a suitable diagnosis" and thereby a validation. The transfer made by Diehl, and the resultant binomial, are unacceptable since the basionym was not the validly-published *Sphaeria epichloe* Kunze. The latter cannot now, however, be the basis of a transfer into *Balansia* Speg. since this action would create a homonym of the illegitimate *Balansia epichloe* (Weese) Diehl. A new name must therefore be established for this fungus and the binomial *Balansia kunzei* Morgan-Jones & Phelps is proposed herein.

As discussed previously elsewhere (Morgan-Jones *et al.*, 1993), the position on host plants where ascostromata of members of the tribe Balansieae are formed in large part determines their final morphology. Each taxon develops primary *Ephelis* anamorph stromata, followed by secondary *Balansia* teleomorph ascostromata, at specific sites; in some cases on leaves or surrounding host culms, in others within and surrounding inflorescences (Diehl, 1950; Morgan-Jones and White, 1989; Morgan-Jones *et al.*, loc. cit.). In each instance, the teleomorph is elaborated by continued growth and modification of hyphae that constitute the primary stromata. In recent years detailed accounts of the development of several species have been published, each with an unique host relationship and individual morphology. These include *Atkinsonella hypoxylon* (Peck) Diehl and the closely related *A. texensis* (Diehl) Leuchtman & Clay, species that form primary stromata enveloping immature inflorescences, bearing hemispherical, pulvinate, localized ascostromata (Leuchtman and Clay, 1989; Morgan-Jones and White, 1989), *Balansia aristidae* (Atk.) Diehl, a species whose flat ascostromata completely encircle the culms of its hosts in the manner of *Epichloe typhina* (Tul.) Fr. (Morgan-Jones *et al.*, loc. cit.), and *Myriogenospora atramentosa* (Berk. & Curt.) Diehl, a fungus that grows entirely epiphytically on adaxial leaf surfaces forming long, narrow, linear ascostromata (Luttrell and Bacon, 1977).

Balansia epichloe (Weese) Diehl is among a very few species that form their stromata on leaf surfaces (Diehl, 1950). It exhibits extensive hyphal growth endophytically in both vascular and ground leaf tissue and egresses inbetween epidermal cells and bulliform cells of longitudinal leaf grooves to form localized, effuse stromata (Phelps *et al.*, 1993b). One to three stromata may be formed on a single leaf blade, each some distance apart and always on the adaxial surface. The somewhat similar species *Balansia henningiana*, that occurs on some of the same hosts as *B. epichloe*, in contrast forms its stromata on the abaxial surface (Diehl, 1950). Following egress a felt-like, cream-colored, prosenchymatous primary stromata is formed in *B. epichloe*, upon which elliptical to long-oblong fertile areas bearing dense clusters of conidiophores develop (Phelps *et al.*, 1994). A study of the transition to ascostromata and the morphology of the teleomorph is reported.

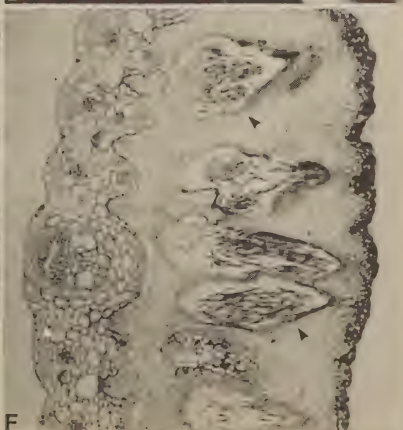
MATERIALS AND METHODS

Specimens of *Balansia epichloe* bearing ascostromata in various stages of development were harvested from plants of *Eragrostis capillaris* (L.) Nees collected in Lee County, Alabama, and maintained in the greenhouse as described by Phelps *et al.* (1993a, 1993b). Sizes of stromata, including length and thickness, and of perithecia represent averages and range of twenty measurements. Leaf segments with ascostromata were prepared for sectioning as described previously (Phelps *et al.*, 1993a), including fixation, infiltration, dehydration, and staining.

RESULTS

Concurrent with the later stages of conidium production, or immediately after cessation of conidiation, the underlying primary stroma becomes progressively denser and assumes a more or less pseudoparenchymatous texture. As this is occurring, or shortly thereafter, perithecium initiation ensues, the perithecia originating, as is typical in other members of the Clavicipitaceae, from ascogonial coils developed in the stromatic tissue a short distance below the surface, as described by Luttrell and Bacon (1977) in *Myriogenospora atramentosa*. A similar condition was described by Morgan-Jones *et al.* (1993) in *Balansia aristidae*. In *B. epichloe* individual perithecia initials quickly appear superficially, as dark spots above the whitish primary stromata, in close proximity to one another (Plate 1, C). As they expand and mature, progressive development of the ascostroma occurs, the perithecia

PLATE 1. Teleomorph of *Balansia kunzei* on adaxial leaf surfaces of *Eragrostis capillaris*. A & B, mature ascostromata (indicated by arrowheads); C, perithecia developing in primary stroma prior to formation of ascostroma [X 10]; D, ascostroma [X 5]; E & F, portions of leaf cross sections showing perithecia (indicated by arrowheads) in ascostroma [E; X 75; F; X 150].



eventually becoming totally embedded. The stroma in the vicinity of and inbetween perithecia tends to remain loosely organized whereas its outer, exposed region assumes a felted appearance superficially, becoming tightly pseudoparenchymatous in texture and composed of more or less isodiametric cells, except in the vicinity of perithecial necks where cells are more elongate (Plate 2, C). Eventually cells in the outer zone become appreciably melanized (Plate 1, F), giving the flat stroma a blackish, carbonaceous appearance (Plate 1, D). When fully developed the ascostroma has a somewhat uneven, rugulose or longitudinally-wrinkled surface, and usually completely, or almost completely, covers the underlying whitish primary stroma, which becomes indistinguishable from the overlying tissue. This may be punctate, giving indication of the position of individual perithecia (Plate 1, D). As the whole structure becomes progressively compacted the internal texture of the ascostromata assumes a largely uniform appearance (Figure 1). At this stage no trace of the subtending primary stroma is discernible. Considerable variation in stromal thickness is evident, even on a single host. Perithecia may be slightly scattered or closely appressed (Plate 1, F). At maturity ascostromata become twice to three times the thickness of the host leaves upon which they are formed (Plate 1, E & F). Perithecial wall cells are elongate and remain clearly distinguishable from the surrounding stromatic tissue at all stages of development. A fascicle of asci is borne from a prominent mound or cluster of ascogenous hyphae occupying the lower part of the perithecial venter (Plate 2, B & D). The sides of the perithecia are lined by evanescent paraphyses (Plate 2, D) and the neck by persistent periphyses (Plate 2, C).

When grown under growth chamber or greenhouse conditions in an extremely warm, humid environment the transition from light colored, effuse, conidiomata-bearing primary stromata into the darker, denser, perithecium-bearing ascostromata frequently fails to occur. Profuse conidiation continues until leaf senescence, when primary stromata dry up, fragment, and disintegrate. This anamorph cycle may continue for up to three months with no teleomorph development. Under such conditions, if and when the teleomorph occurs, dark perithecial initials develop directly from the effuse primary stroma, speckling its white surface. Only then does the ascostroma become black and pseudoparenchymatous. Transition from the anamorph state to the teleomorph tends to occur on numerous leaves, or even plants, simultaneously. In nature, our observations suggest that the primary *Ephelis* state is relatively short-lived, the *Balansia* ascostroma forming soon after leaf expansion.

TAXONOMIC DESCRIPTION

Balansia kunzei Morgan-Jones et Phelps nom. nov.

= *Sphaeria epichloe* Kunze, Weigelt *fungi exsiccati* 1837.

≡ *Botryosphaeria epichloe* (Kunze) Sacc., *Bull. R. Soc. Bot. Belg.* 31:227, 1892 [name misapplied].

≡ *Dothichloe epichloe* (Kunze) Weese, *Sber. Akad. Wiss. Wien* 128:118, 1919.

[≡ *Balansia epichloe* (Weese) Diehl, *USDA Agric. Monogr.* 4:40, 1950.]

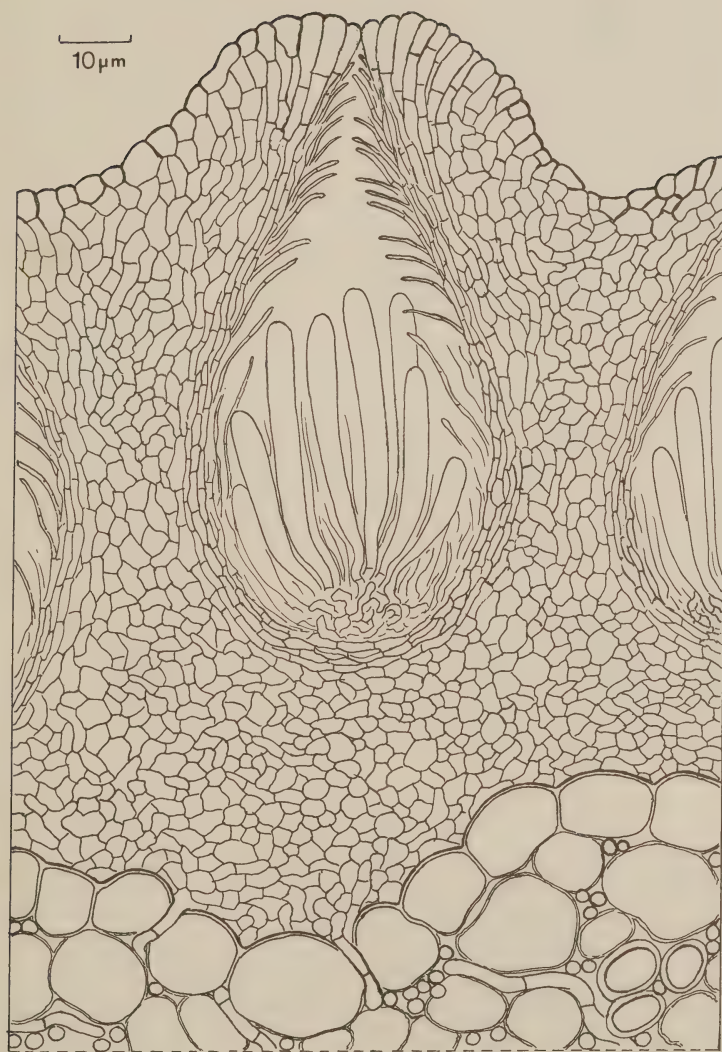


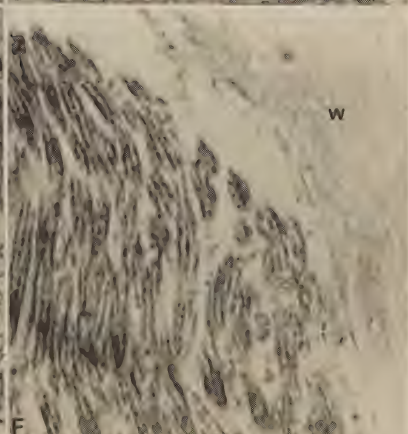
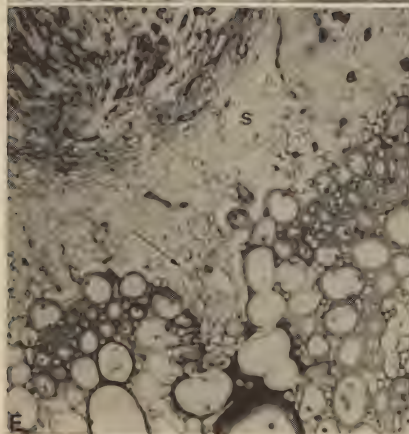
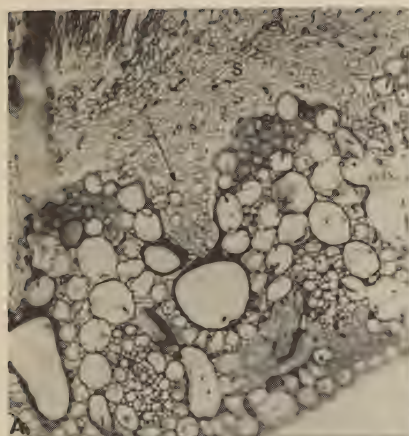
FIGURE 1. *Balansia kunzei*. Section through portion of young ascostroma.

- = *Dothidea atramentaria* Berk. & Curt., apud Berk., *Grevillea* 4:105, 1876 [nom. nud.].
- ≡ *Dothidea atramentaria* Berk. & Curt. f. *eragrostidis-capillaris* Thum., *Myc. univ.* 1068, 1879 [nom. nud.].
- ≡ *Ophiodothis vorax* (Berk. & Curt.) Sacc. var. *atramentaria* (Berk. & Curt.) Sacc., *Syll. Fung.* 2:652, 1883.
- ≡ *Dothichloe atramentaria* (Berk. & Curt.) Atk., apud Davis, *Trans. Wis. Acad. Sci. Arts Lett.* 24:299, 1929.
- = *Dothichloe limitata* Diehl, *J. Agric. Res.* 58:948, 1939.

Etymology: in honor of Gustav Kunze [1793-1851], who first named and described this fungus.

Ascostromata (Plate 1, B & D) on adaxial leaf surfaces, usually single, one per leaf, or, more rarely, up to three on a leaf, each some distance apart, flat, effuse, mostly entirely covering the primary stromata, maculiform, up to 18mm in length, width to a large extent dependent on that of the host leaf, surface more or less even but becoming rugulose, longitudinally wrinkled when fully mature, irregularly punctate from slightly protruding perithecia, carbonaceous black, 150-435µm thick. Internal texture pseudoparenchymatous, composed of isodiametric or elongate, subhyaline to very pale brown, cells, those in proximity to the surface thick-walled and distinctly melanized (Plate 1, F). Perithecia entirely immersed, frequently crowded, with necks often somewhat protuberant, obpyriform to lageniform, flattened laterally when compressed, 140-340µm long, 50-150µm in diameter in the broadest part (Figure 1; Plate 2, D); perithecial wall composed of interweaving, elongate cells, up to 14µm wide. Paraphyses filiform, evanescent. Periphyses in the neck region persistent (Plate 2, C). Asci borne from a mound of ascogenous hyphae located at the base of the perithecium (Plate 2, B & D), cylindric, tapering toward the base, 130-180 X 4-6µm, each containing eight ascospores (Plate 2, F). Ascospores filamentous, hyaline, 7-septate, up to 120µm in length, disarticulating into four separate, 1-septate, partspores, each 35-(39)-50µm long, 1-1.5µm wide.

PLATE 2. Portions of thin sections showing the teleomorph of *Balansia kunzei* on adaxial leaf surfaces of *Eragrostis capillaris*. A, leaf in cross section showing longitudinal groove (indicated by arrow) and pseudoparenchymatous stroma (s) [X 400]; B-D, perithecia in longitudinal section showing ascogenous regions (a), asci (indicated by arrowheads), wall structure, ostioles (o), and periphyses (p) [X 600]; E, leaf in cross section showing longitudinal groove (indicated by arrow), pseudoparenchymatous stroma (s), and base of perithecium [X 400]; F, portion of perithecium in longitudinal section showing a mass of spore-bearing asci and the surrounding wall (w) [X 1000].



On leaves of species of *Andropogon* L., *Calamagrostis* Adams., *Chloris* Sw., *Ctenium* Panz., *Eragrostis* Wolf, *Gymnopogon* P. Beauv., *Panicum* L., *Sporobolus* R. Br., *Triodia* R. Br.; North, Central and South America.

Collections examined: on *Eragrostis capillaris*, Auburn, Lee County, Alabama, August 1991, G. Morgan-Jones, AUA; on *E. elliottii*, Geneva County, Alabama, July 1991, R.A. Phelps, AUA.

DISCUSSION

The development of the ascostromata of *B. kunzei* is essentially similar to that of *Balansia aristidae* (see Morgan-Jones *et al.*, 1993) although the latter are formed around culms rather than leaves. In both, a primary, *Ephelis*-bearing stroma becomes converted into an ascostroma by virtue of further growth following cessation of conidiation or partly concurrent with it. There is quite often an overlap between the two stages. The ascostromata of *B. kunzei* are generally rather better developed than in those of a species such as *B. aristidae* in the sense that more sterile tissue is elaborated around the perithecia. As a result, the latter are more substantially immersed in the structure and the ascostroma has a more even surface. In *Balansia strangulans* (Mont.) Diehl, a species that, like *B. aristidae*, forms stromata around culms, perithecia are, however, immersed to an equivalent extent as in *B. kunzei*.

The flat, effuse stromata of *B. kunzei* broadly resemble those of *B. henningsiana*, a species with which it has often been confused in the past (Diehl, 1950). Occurring as they do on some of the same hosts, including *Andropogon scoparius* Michx., *Gymnopogon ambiguus* (Michx.) B.S.P., and *Panicum agrostoides* Spreng., this is not surprising given their superficial similarity. They differ, as already mentioned, in that the stromata of *B. henningsiana* are invariably formed on abaxial leaf surfaces.

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NOTES ON COELOMYCETES. V.
CONCERNING MARSSONINA VERATRI, A LEAF-SPOT
CAUSING FUNGUS OF VERATRUM CALIFORNICUM,
RECLASSIFIED IN COLLETOGLOEUM

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ABSTRACT

Marssonina veratri (Ellis & Everh.) Magnus is redescribed and illustrated from its type collection. Its synonymy with *Gloeosporium veratri* (Allesch.) Höhn. is found to be erroneous. It is unsatisfactorily classified in *Marssonina* Magnus and is transferred to *Colletogloeum* Petrak as *C. veratri* (Ellis & Everh.) Morgan-Jones & Phelps.

INTRODUCTION

The fungus presently known as *Marssonina veratri* was originally named *Marsonia veratri* Ell. & Everh. and described from a collection made on leaves of *Veratrum californicum* E.M. Durand in Pullman, Washington (Ellis and Everhart, 1895). It was given the following diagnosis "Spots amphigenous, small (2-3 mm.), whitish, with a broad, dull-purple border, which is often elongated in the direction of the veins of the leaf for 2-3 cm., with the ends acute, finally more or less confluent, the entire leaf becoming brown and dead. Acervuli small, occupying the center of the spots, or irregularly scattered over them. Conidia clavate-cylindrical, curved, upper end subtruncate, lower end attenuated and subacute, uniseptate, hyaline, 18-22 X 3-3.5 µm."

There has, regrettably, been some confusion over the true identity of *Marssonina veratri* resulting from its erroneous listing by Petrak (1937) as a synonym of *Gloeosporium veratri* [= *Fusoma veratri* Allesch.]. *Fusoma veratri* and its obligate synonyms *G. veratri* and *Septogloeum veratri* (Allesch.) Wollenw. are facultative synonyms of *Mycocentrospora veratri* (Peck) U. Braun [= *Cercospora veratri* Peck] (Ondřej, 1974; Braun, 1991; Morgan-Jones and Phelps, 1995), a different fungus. The incorrect synonymy instigated by Petrak (loc. cit.) was perpetuated by von Arx (1970) and by Farr *et al.* (1989) so that until recently the binomial *Marssonina veratri* has had subservient, misapplied status. Morgan-Jones & Phelps (loc. cit.), following examination of its type specimen, determined its independent nature but deferred providing an account of its characteristics. Such is provided herein.

The generic name *Marssonina* was established by Magnus (1906) as a new name for *Marssonia* J.C. Fischer [*Fungi europaei exsiccati* cent. XIX. no. 1857, 1874] because of the latter being a later illegitimate homonym of *Marssonia* H. Karsten [*Fl. Columb.* 1. 97. t. 48, 1861] (a synonym of *Napeanthus* Gardn.), a genus of the flowering plant family Gesneriaceae. Magnus (loc. cit.) opined that the name [spelling] *Marsonia*, used by Saccardo (1880), and subsequently perpetuated by him (Saccardo, 1884) and a number of others, including Ellis and Everhart (1895), was a *lapsus calami* for *Marssonia*. The genus had been named in honor of a Dr. Th. Fr. Marsson, a pharmacist of Greifswald. A total of sixty-six species, mainly the taxa of *Marssonia* [as *Marsonia*] included in Saccardo's *Sylloge Fungorum*, were transferred into *Marssonina* by Magnus. Von Arx (1957) considered *Marssonina* to be a later name for *Gloeosporium* Desm. & Mont. but advocated in favor of its conservation to maintain relatively long and well-established usage.

The vast majority of species described in *Gloeosporium*, not viewed as being congeneric with its type species, *G. castagnei* Desm. & Mont., have been dispersed elsewhere, mostly by von Höhnelt (1916) and von Arx (1957). Sutton (1977) suggested that sufficient difference in conidial morphology and conidiomatal position in host tissue exists to differentiate *Gloeosporium* from *Marssonina*. The acervuli of the former are epidermal to subepidermal, whereas those of the latter are subcuticular. Sutton (1980), however, listed *Gloeosporium* as a synonym of *Marssonina* with a *nomen rejiciendum propositum* proviso. *Gloeosporium castagnei* was among the many species classified by Magnus (loc. cit.) in *Marssonina* [as *M. castagnei* (Desm. & Mont.) Magnus]. Since *Gloeosporium*, established in 1849, predated *Marssonina* J.C. Fischer by some twenty-five years and Magnus considered its type species congeneric with *Marssonina potentillae* (Desm.) Magnus [= *Phyllosticta potentillae* Desm.], the type species of his *Marssonina*, adoption of the former generic name would have obviated the need for the coining of a generic *nomen novum*. As Sutton (1977) argued there is, however, enough of a difference to separate *Gloeosporium* from *Marssonina*. *Marssonina potentillae* is now considered a synonym of *M. fragariae* (Lib.) Kleb., the valid name for the type species of *Marssonina*.

Sutton (1980) noted the probable heterogeneous nature of *Marssonina* and suggested that a modern revision of it would lead to the dispersion elsewhere of many of the more than one hundred and fifty taxa accommodated within it. Because of a wide range of conidial morphology, conidiomatal structure, and host-substrate relationship, it is evident that reclassification of many species of *Marssonina* is desirable. In the case of *M. veratri* our studies have indicated that it cannot continue to be considered congeneric with *Marssonina fragariae* (Lib.) Kleb., the type species of the genus. It has the characteristics of *Colletogloeum* Petrak and is, accordingly, transferred into that genus.

The genus *Colletogloeum*, which remained monotypic for almost two decades following its recognition, was established by Petrak (1953) for a fungus described in the same year by Ahmad [apud Ahmad and Lodhi (1953)] as

Septogloeum dahlbergiae Ahmad [= *Colletogloeum dahlbergiae* (Ahmad) Petrak]. The same fungus had previously been named *Cercospora sissoo* Syd. (Sydow, 1933). Sutton (1964) made the recombination *Colletogloeum sissoo* (Syd.) Sutton, the valid binomial of the type species, and redescribed the genus. Pollack and Sutton (1972), Sutton (1975, 1980) and Singh (1977) have subsequently added eight additional taxa, four as new species, three as recombinations from *Coryneum* Nees, and one from *Septogloeum*. More recently Ganapathi and Corbin (1979), Sutton and Mehrotra (1982), Sutton and Swart (1986), and Sivanesan (1987), have added six further species to the genus, bringing the present total to fifteen, not counting the taxon described in this paper. Of these six species, five were novel and one transferred from *Marssonina*. Anamorphs of two different pseudothecial teleomorph Ascomycete genera are now accommodated within *Colletogloeum*; namely *C. nubilosum* Ganapathi & Corbin, the anamorph of *Mycosphaerella nubilosa* (Cooke) Hansf., and *C. perseae* Sivanesan, the anamorph of *Coccoidella perseae* Sivanesan (Ganapathi and Corbin, loc. cit.; Sivanesan, loc. cit.). Unlike other species of *Colletogloeum* both these have associated microconidial, spermogonial states.

TAXONOMIC PART

Colletogloeum veratri (Ell. & Everh.) comb. nov. (Figure 1).

= *Marsonia veratri* Ellis & Everhart, *Proc. Acad. Nat. Sci. Philadelphia* :373, 1895.

= *Marssonina veratri* (Ell. & Everh.) Magnus, *Hedwigia* 45:91, 1906.

Leaf lesions amphigenous, orbicular to ellipsoid, whitish to very pale cinnamon-brown at the center, much darker toward the periphery, sometimes zonate with alternating pale and dark bands, often with a broad, dark chocolate-brown to purple-brown margin that often extends some distance linearly, parallel to the leaf veins, giving a navicular overall aspect, up to 6mm wide, up to 1cm in length not including the dark-brown, often pointed, linear elongations that may be up to 3cm from end to end, discrete or sometimes with the lengthwise marginal extensions becoming confluent; lesions slightly paler and less prominent when viewed from the abaxial surface. Mycelium immersed in the host substrate, mostly intercellular inbetween mesophyll cells, composed of hyaline to subhyaline, branched, septate, smooth-walled, 2.5-4µm wide hyphae. Conidiomata epiphyllous, cinnamon-colored, acervular, epidermal, sometimes extending slightly and irregularly to become in part subepidermal inbetween disintegrating mesophyll cells, erumpent, limited to the pale central necrotic tissue, more or less flat, up to 230µm in diameter, with a 20µm thick layer of pseudoparenchymatous basal tissue, composed of very pale brown, thin-walled, isodiametric, 4-5.5µm wide cells. Conidiophores semimacronematous, cylindrical, sometimes slightly swollen toward the base, subhyaline, smooth-walled, 0 to 1-septate, unbranched, originating in a dense palisade from the upper cells of the basal stromatic tissue, 11-19 X 3-4.5µm. Conidiogenous cells holoblastic, terminal, with up to three apical percurrent proliferations. Conidia broadly fusiform to obclavate, curved, sometimes strongly bent, tapered distally

toward a subacute apex, attenuating slightly toward a broad truncate base, subhyaline, smooth, 0 or 1-septate, 16-31 X 2.5-4µm.

On leaves of *Veratrum californicum* E.M. Durand [Liliaceae]; North America.

Collection examined: on *V. californicum*, Pullman, Washington, U.S.A., August 1893, C.V. Piper, NY, holotype.

DISCUSSION

In the original description of this taxon Ellis and Everhart (1895) evidently mistook the subtruncate base of the conidia for the apex and the attenuated, subtruncate apex as the base. In conidial dimensions and morphology *C. veratri* somewhat resembles *C. artocarp*i S.M. Singh, which occurs on leaves of species of *Artocarpus* J.R. Forster & G. Forster [Moraceae] in India and Nepal (Singh, 1977; Sutton, 1980). *Colletogloeum rhois* (Halst.) Sutton, which is known only from its type collection made on leaves of *Rhus toxicodendron* L. in New Jersey, U.S.A., has similarly shaped conidia that taper noticeably toward a subacute apex, unlike those of *C. sissoo*, the type species, that are more or less cylindrical and have an obtuse apex. *Colletogloeum acaciicola* Sutton & Swart and *C. glochidiicola* (Seshadri) Sutton are additional species with markedly attenuated conidia. Conidia of *Colletogloeum* vary in coloration from hyaline to pale brown; *C. acaciae* (Cooke & Massee) Sutton & Swart, *C. artocarp*i, *C. protii* Sutton & Mehrotra, and *C. rhois* having the latter characteristic.

It is evident that *Colletogloeum*, in company with a number of other leaf-borne acervular anamorph genera such as *Cryptocline* Petrak, *Marssonina* Magnus, *Monostichella* Höhn., and *Phloeospora* Wallr., is, at present, somewhat heterogeneous. With regard to generic concepts in such fungi a broad approach based on acervulus morphology and host-substrate relationship, together with conidiophore morphology and conidiogenesis peculiarities, can be adopted. Alternatively, a narrower concept where monothetic differences in conidium shape, septation and pigmentation assume greater importance, has, in some instances, been advocated.

Criteria for genus recognition in this complex have not, historically, been applied evenly and consistently which results in a need for critical revisionary studies. The monotypic genus *Ahmadia* Sydow, for example, differs from *Colletogloeum* only by possession of subcuticular rather than subepidermal conidiomata. In conidiophore and conidium characteristics its type and only species, *A. pentatropidis* Sydow, is not dissimilar to *C. sissoo*. A species such as *C. glochidiicola*, in contrast, bears conidia that are much more pigmented, appreciably thicker-walled, and are of a different shape. This taxon, which was originally classified as a species of *Coryneum* Nees, was removed from that genus because its conidia are euseptate rather than distoseptate (Sutton, 1975). Eventually its classification in *Colletogloeum* may need to be reevaluated. The generic distinction between *Colletogloeum* and *Phloeospora*,

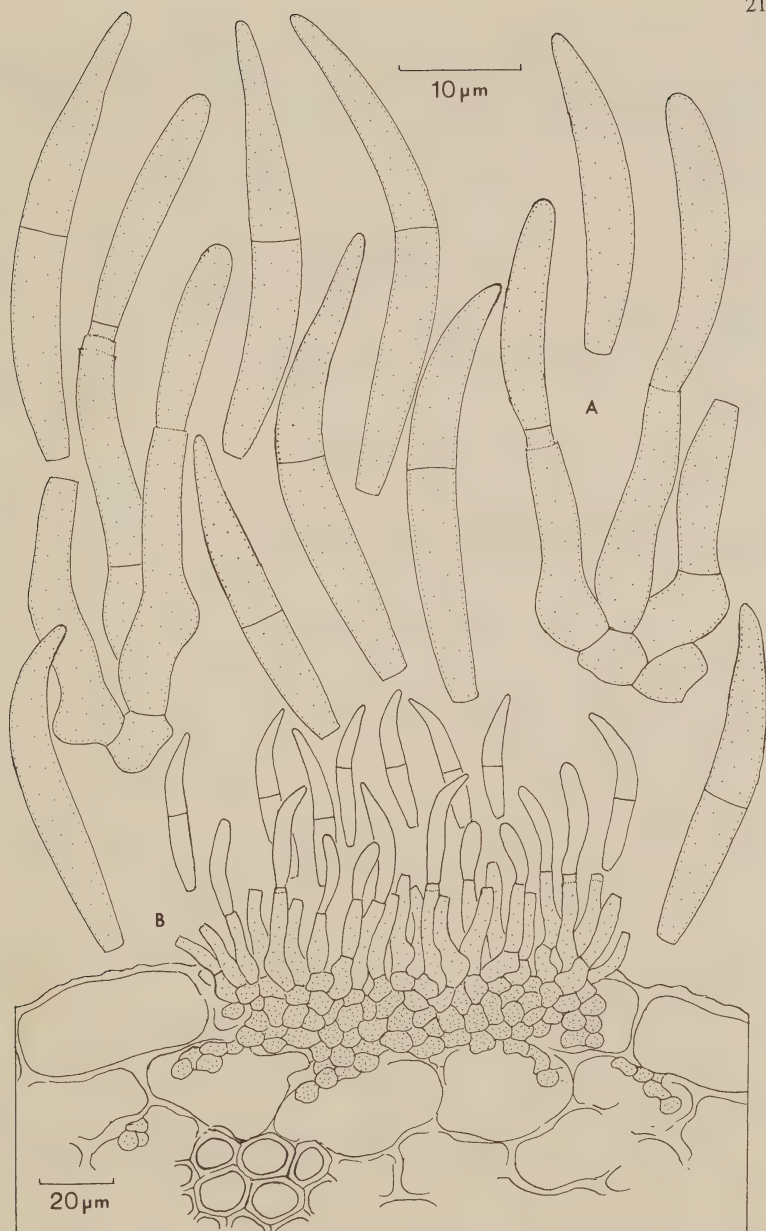


FIGURE 1. *Colletogloeum veratri*. A, conidia and conidiophores; B, vertical section of acervular conidioma.

based in large part on entire lack of pigmentation of conidiophores and conidia in the latter, is by no means substantial. The addition of *C. perseae* extended the limits of *Colletogloeum* in that its conidia are rostrate, bearing a long apical, cellular, branched or unbranched appendage. Differences in conidial morphology were not considered sufficient by Sivanesan (1987) to warrant recognition of a separate genus. Nevertheless, given the generic concepts traditionally applied to this complex, a reassessment of this view may not be inappropriate.

As things stand at present, as indicated above, *Colletogloeum* anamorphs are associated with two Loculoascomycete genera, *Coccoidella* and *Mycosphaerella*. This is a similar situation to that existing in *Marssonina* where species are associated with two genera of the Helotiales. Some have *Diplocarpon* F.A. Wolf teleomorphs, while others are anamorphs of *Drepanopeziza* (Kleb.) Höhn. (Wolf, 1912, 1924; Rimpau, 1962). Clearly, the classification of these anamorphs is not, currently, as natural as it can and should be.

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MISCELLANEOUS NOTES ON PHYTOPATHOGENIC HYPHOMYCETES (II)

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Summary: The present paper contains the description of the new species *Ramularia hyperici* and 29 new combinations into *Camptomeris*, *Cladosporium*, *Mycovellosiella*, *Passalora*, *Phaeoramularia*, *Pseudocercospora* and *Stenella*.

(1) *Camptomeris* Syd.

(1.1) *Camptomeris pulchra* (H. Sydow) U. Braun comb. nov.

Fig. 1

Basionym: *Cercospora pulchra* H. Sydow, Ann. Mycol. 35: 241 (1937).

Syntypus: on *Crataeva religiosa* (Capparidaceae), India, Allahbad, 11-10-1933, Mitter No. 252 (GZU).

Description: Vaduseva (1961: 171).

Chupp (1954: 98) suggested that this fungus does not belong to *Cercospora*. *C. pulchra* is characterized as follows: Leaf spots amphigenous, scattered to confluent, greyish green, yellowish, later brown, margin indefinite. Mycelium internal, forming substomatal stromata, olivaceous brown, 10-30 μm diam., somewhat erumpent with a few, large, swollen cells which bear a single or often two or more subcylindrical to clavate, straight or often somewhat curved conidiophores, fasciculate in small sporodochia, usually 20-40 x 4-8 μm , olivaceous brown, conidial scars conspicuous, thickened and darkened, about 2 μm wide. Conidia solitary, obclavate-fusiform, 30-65 x 5-8 μm , 2-4 (-6)-distoseptate, smooth to faintly rough, olivaceous brown, apex elongated, narrowed, pale, often almost colourless, mostly curved, base obconically truncate, hila unthickened, often somewhat darkened.

The conidiogenesis could not be observed in detail, but it is undoubtedly polyblastic. *C. pulchra* is the only *Camptomeris* on a host plant not belonging to the legumes and it differs from the other members of the genus by usually smooth conidia with curved, colourless apices. Nevertheless, *Camptomeris* seems to be the only appropriate genus for this species (cf. Hughes, 1952; Ellis, 1971).

(2) *Cladosporium* Link(2.1) *Cladosporium inopinum* (Petrak) U. Braun comb. nov.

Fig. 2

Basionym: *Cercospora inopina* Petrak, Sydowia: 570 (1950).Syntypus: on *Gynoxys hallii* (Asteraceae), Ecuador, Pichincha, near Quito, 20-9-1937, H. Sydow, Reliquiae Petrakianae 1350 (GZU).

Chupp (1954) excluded this species from *Cercospora*. *C. inopinum* is characterized by catenate conidia and thickened, protuberant conidial scars (*Cladosporium* type): Leaf spots indistinct, hyphae mainly external, on trichomes, subhyaline-greenish, olivaceous to brown, septate, branched, smooth, rarely faintly rough, 1-5 μm wide, forming small stromata, composed of brown swollen cells, fairly thick-walled, 4-9 μm wide. Conidiophores erect or horizontal, solitary to fasciculate, arising from small stromata or creeping hyphae, 10-120 x 3-7 μm , subcylindrical, straight to geniculate-sinuous, simple, occasionally branched, sometimes with constrictions and swollen segments, olivaceous brown, smooth, continuous or septate, conidial scars thickened and darkened, somewhat protuberant. Conidia catenate, occasionally in branched chains, ellipsoid-ovoid, subcylindrical, (8-) 10-30 (-35) x 2.5-6 μm , 0-3 (-4)-septate, olivaceous to brown, smooth to faintly rough, hila thickened and darkened, often somewhat protuberant.

(3) *Mycovellosiella* Rangel(3.1) *Mycovellosiella hymenodictyi* (Petrak) U. Braun comb. nov.

Fig. 3

Basionym: *Cercospora hymenodictyi* ("hymenodictyonis") Petrak, Sydowia 10: 124 (1957).Syntypus: on *Hymenodictyon excelsum* (Rubiaceae), Philippines, Luzon, Prov. Bulacan, Santa Maria, XI. 1934, M. S. Clemens, Reliquiae Petrakianae 1349 (GZU).

Leaf spots amphigenous, subcircular to angular-irregular, 2-8 mm diam., brownish. Colonies usually hypophyllous. Primary mycelium internal, secondary mycelium external, superficial, creeping hyphae sometimes climbing leaf hairs, septate, branched, coloured, 2-4 μm wide, smooth. Stromata well-developed, substomatal, 10-25 μm diam., brownish. Conidiophores in small fascicles, emerging from stromata, through stomata, or solitary, arising from creeping hyphae, subcylindrical, straight to slightly geniculate-sinuous, 8-60 (-80) x 3-7 μm , simple, pale brown, continuous to septate, smooth, conidial scars somewhat thickened and darkened. Conidia solitary, obclavate-cylindrical, 30-70 x 4-6.5 μm , 2-6 (-7)-septate, subhyaline to pale olivaceous brown. Because of the secondary mycelium, this species must be transferred to *Mycovellosiella*.

(3.2) *Mycovellosiella toxicodendri* (Ell.) U. Braun comb. nov.

Fig. 4

Basionym: *Cercospora toxicodendri* Ell., Amer. Nat. 16: 811 (1882).Holotypus: on *Rhus toxicodendron* (Anacardiaceae), USA,

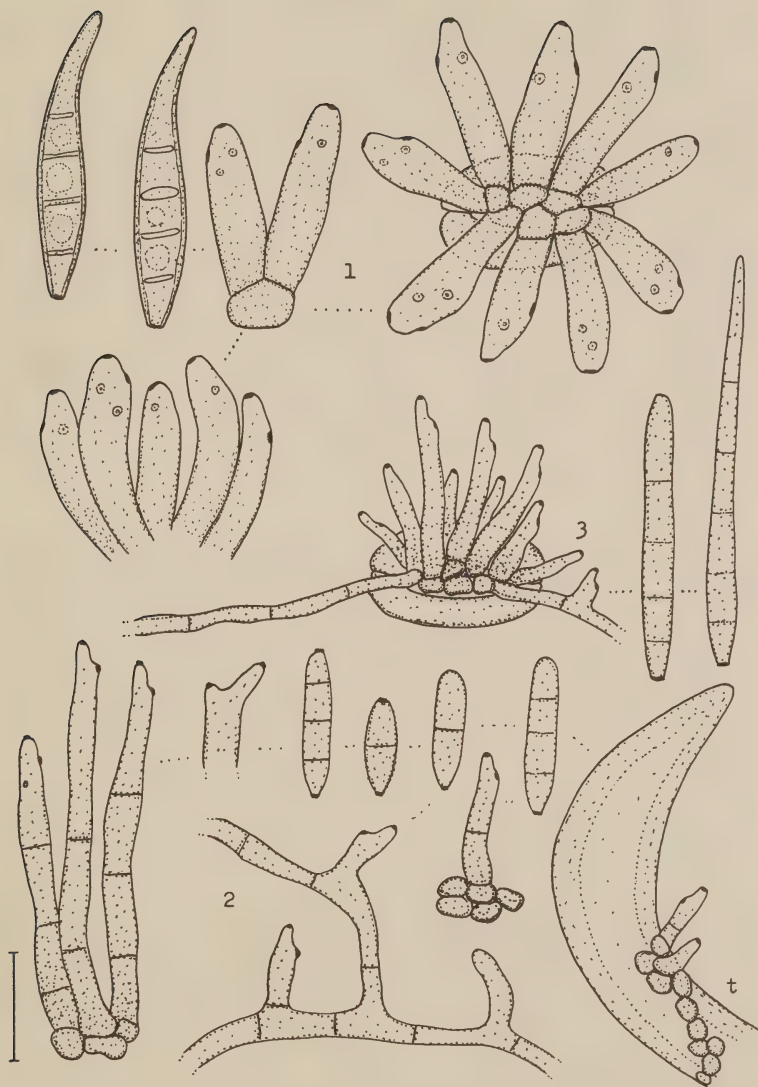


Fig. 1-3. Conidiophores, conidia, superficial hyphae, (1) *Camptomeris pulchra*, (2) *Cladosporium inopinum* (t - infected trichome), (3) *Mycovellosiella hymenodictyi*. Scale 20 μm . U. Braun del.

Newfield, N.J., July 1882, Ellis 1347a (NY).

Syn.: *Pseudocercospora toxicodendri* (Ell.) Liu & Guo, *Mycosystema* 2: 237 (1989).

Description: Chupp (1954: 43).

Leaf spots small, indistinct, irregular, greenish to brown, 1-5 mm diam. Primary mycelium internal, superficial secondary mycelium poorly to well-developed, septate, branched, smooth, coloured, usually 1.5-4 μ m diam. Stromata almost absent or small. Conidiophores in small to fairly rich fascicles or solitary, arising from creeping hyphae, lateral, occasionally terminal, usually 10-50 x 3-6 μ m, 0-1-septate, brownish, smooth, conidial scars somewhat thickened and darkened. Conidia solitary, obclavate-cylindrical, subhyaline to pale olivaceous 20-180 x 2.5-5 μ m, 2-9-septate, smooth, apex subobtuse, base obconically truncate, slightly thickened.

Superficial secondary mycelium is poorly to well-developed. The conidiophores are fasciculate and partly solitary, arising from creeping hyphae, and possess thickened and darkened conidial scars. Hence, this species belongs to *Mycovellosiella*. Numerous specimens from different herbaria have been examined (e.g. GZU, HAL, NY).

(4) *Passalora* Fr. emend.

Deighton (1967) re-defined *Passalora* Fr. and distinguished *Cercosporidium* Earle by well-developed stromata. Within the *Cercospora* complex, the characteristics of stromata are useful specific features, but unsuitable to discriminate genera. Furthermore, stromata are not absent in *Passalora bacilligera* Fr. & Mont. (= type species of this genus). They are small but conspicuous, agreeing with the size of the substomatal cavities of the attacked leaves (cf. Arx, 1983). Therefore, Arx (1983) treated *Cercosporidium* as synonymous with *Passalora* and this has been followed by Castañeda and Braun (1989), Deighton (1990) and Braun (1992). The conidial scars (*Passalora* type) are almost unthickened to slightly thickened and slightly to obviously darkened (Deighton, 1990; Braun, 1992). True *Cercospora* s.str. scars are conspicuously thickened and darkened. The size of the scars is variable and depends on the width of the conidial hila. *Cercospora* scars are mostly broad, dark and very conspicuous, but fairly minute in some species with very narrow conidia. The differences between slightly thickened *Passalora* scars and conspicuously thickened *Cercospora* scars are, of course, only gradual. But the different types of conidial scars combined with characteristic conidia (shape, size, colour) warrant the clear separation of *Cercospora* and *Passalora*.

Cercospora (s.str.) conidia (*Cercospora* type or *Cercospora*-like) are long, narrow, acicular (- very narrowly obclavate), narrowly cylindrical, filiform, obscurely multiseptate, rarely 0-4-septate (in very narrow, shortly acicular conidia), hyaline or subhyaline (with a faintly greenish tinge), rarely pale olivaceous, apex more or less acute, sometimes obtuse, base truncate to shortly obconically truncate, hila thickened and darkened.

Conidia of the *Passalora* type are not *Cercospora*-like,

but ellipsoid-ovoid, broadly fusiform, clavate, obclavate, subcylindrical, colourless to pigmented, usually fairly broad (about 4-15 μm wide; occasionally narrowly obclavate, about 3-5 μm wide, but obviously coloured), few septa (usually 0-4; occasionally multiseptate, 3-8 or even more septa, but conidia broadly obclavate and pigmented).

The characteristics of the conidia and conidial scars in *Passalora* and *Phaeoisariopsis* are identical (cf. Deighton, 1990). The latter author confined *Phaeoisariopsis* to synnematal species with conidial scars lying more or less flat against the sides of the conidiogenous cells and proposed to transfer species with more or less geniculate conidiogenous cells to *Passalora*. Braun (1992) did not agree with this treatment. The displacement of the conidial scars on the conidiogenous cells is a good specific feature, but untenable for generic delimitations. There are transitions in *Phaeoisariopsis* as well as *Passalora* s.str. (incl. *Cercosporidium*). Therefore, I prefer to recognize *Phaeoisariopsis* as a synnematal counterpart to *Passalora* (cf. Braun, 1992). The three genera can be keyed out as follows:

1. Conidiophores solitary to fasciculate, conidial scars obviously thickened and darkened (*Cercospora* type), conidia acicular to narrowly subcylindrical (- very narrowly obclavate, filiform), long and narrow, hyaline or subhyaline (rarely faintly olivaceous), obscurely multiseptate (rarely 0-4-septate in narrow, shortly acicular conidia) *Cercospora*
1. Conidiophores fasciculate to synnematal, conidial scars almost unthickened to slightly thickened, somewhat darkened (*Passalora* type), conidia not *Cercospora*-like, ellipsoid-ovoid, broadly subcylindrical, clavate, obclavate, hyaline to coloured, mostly 4-15 μm wide, rarely narrower, but obclavate and coloured, few septa (usually 0-4), occasionally 3-8 or even more septa, but conidia obclavate, broad, coloured 2
2. Conidiophores very long and closely appressed, synnematal *Phaeoisariopsis*
2. Conidiophores loosely fasciculate *Passalora*

Owing to the characteristics of the conidial scars and conidia, the following species must be referred to *Passalora*. Brief descriptions and illustrations are added in order to elucidate the altered circumscription of *Passalora*. Detailed descriptions and illustrations are to be found in Chupp (1954), Ellis (1976) and some other publications. Therefore, they are not copied in the present paper.

(4.1) *Passalora aberrans* (Petrak) U. Braun comb. nov. Fig. 5
 Basionym: *Cercospora aberrans* Petrak, Sydowia 10: 122 (1957).

Syntypus: on *Bridelia glabrifolia* (Euphorbiaceae), Philippines, Porac, Luzon, 30-10-1923, M. S. Clemens, Reliquiae Petrakianae 551 (GZU).

Syn.: *Pseudocercospora aberrans* (Petrak) Deighton (1987: 388).

Leaf spots amphigenous, 3-5 mm diam., angular, brownish, centre later greyish white. Caespituli amphigenous, usually

hypophyllous, punctiform, pustulate, dark. Mycelium internal, forming large stromata, 30-80 μm diam. Conidiophores numerous, fasciculate, arising from stromata, divergent, simple, occasionally branched, straight, subcylindrical to slightly geniculate-sinuous, septate, pale olivaceous, usually 20-100 x 4-6 μm , conidial scars hardly thickened, but somewhat darkened, conspicuous. Conidia solitary, broadly obclavate, fusiform, 15-35 x 4.5-6.5 μm , 1-4-septate, fairly thick-walled, subhyaline or pale.

Deighton (1987) referred this species to *Pseudocercospora*, but the conidial scars and hila are conspicuous, hardly thickened, but somewhat darkened. Therefore, this species must be placed in *Passalora*.

(4.2) *Passalora bellynckii* (Westendorp) U. Braun comb. nov. Fig. 6

Basionym: *Cladosporium bellynckii* Westendorp, Bull. Acad. Roy. Belg. II, 21: 240 (1854).

Syn.: *Cercospora bellynckii* (West.) Niessl, Hedwigia 15: 1 (1876). *Cercosporidium bellynckii* (West.) Liu & Guo (1982: 93).

Description: Chupp (1954: 69).

Illustration: Liu & Guo (1982: 89, fig. 1/2).

The conidial scars in this species are almost unthickened to slightly thickened, somewhat darkened and the conidia are obclavate, olivaceous, about 4-7 μm wide. Type material has not been examined, but numerous other specimens, e.g. Sacc., Myc. ven. 283 and Thüm., Myc. univ. 1567, on *Vincetoxicum hirundinaria* (HAL).

(4.3) *Passalora bolleana* (Thüm.) U. Braun comb. nov. Fig. 7

Basionym: *Septosporium bolleanum* Thüm., Oesterr. Bot. Zeitschr. 27: 12 (1877).

Syn.: *Cercospora bolleana* (Thüm.) Speg., Michelia 1: 475 (1879). *Cercosporidium bolleanum* (Thüm.) Liu & Guo (1982: 93). *Pseudocercospora bolleana* (Thüm.) Sivanesan (1984: 206).

Description: Chupp (1954: 392), Sivanesan (1984: 205).

Illustration: Liu & Guo (1982: 89, fig. 1/3), Sivanesan (1984: 205, fig. 107 B).

The conidial scars are conspicuous, almost unthickened to slightly thickened, somewhat darkened. The conidia are subcylindrical to broadly obclavate, olivaceous and usually 1-3-septate. This species is a typical *Passalora*. Type material could not be examined, but numerous additional samples on *Ficus carica* [e.g. Reliquiae Petrakianae 1147 (GZU); Briosi & Cav., Funghi paras. 85; Sacc., Myc. ven. 1564 (HAL)].

(4.4) *Passalora campi-silii* (Speg.) U. Braun comb. nov.

Fig. 8

Basionym: *Cercospora campi-silii* Speg., Michelia 2: 171 (1880).

Syn.: *Cercosporidium campi-silii* (Speg.) Liu & Guo (1982: 94).

Description: Chupp (1954: 77).

Illustration: Liu & Guo (1982: 89, fig. 1/4).

The conidial scars are slightly thickened and obviously

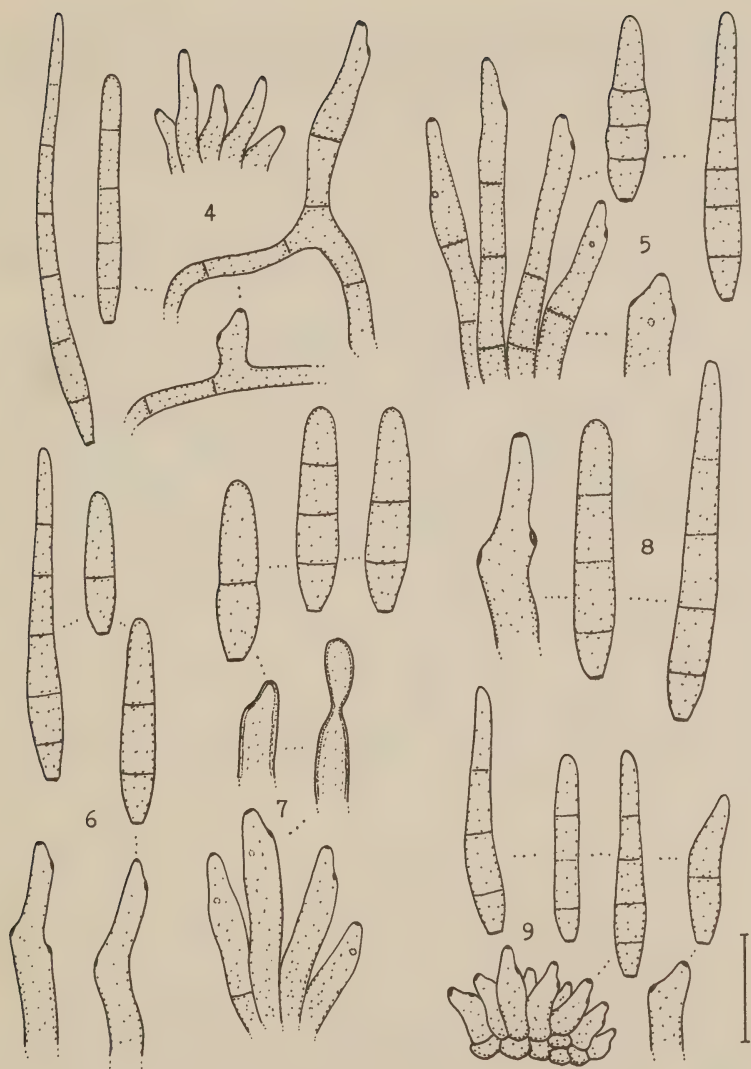


Fig. 4-9. Conidiophores, conidia, (4) *Mycovellosiella toxicodendri*, (5) *Passalora aberrans*, (6) *P. bellynckii*, (7) *P. bolleana*, (8) *P. campi-silii*, (9) *P. cardopati*. Scale 20 μm . U. Braun del.

darkened. The conidia are broadly obclavate-subcylindrical, 4-7 μm wide and 1-6-septate (*Passalora* type). Several specimens on *Impatiens noli-tangere* have been re-examined [e.g. Syd., Myc. germ. 2034; Syd., Myc. march. 2180, 3587; Krieger, Fungi sax. 746 (B, GZU, HAL)].

(4.5) *Passalora cardopati* (Bremer & Petrak) U. Braun comb. nov. Fig. 9

Basionym: *Cercospora cardopati* Bremer & Petrak, Sydowia 1: 260 (1947).

Syntypus: on *Cardopatum corymbosum* (Asteraceae), Turkey, Adana, Adali, 8-6-1943, Karel, Reliquiae Petrakianae 554 (GZU).

Description: Chupp (1954: 126).

Leaf spots subcircular to angular, 2-6 mm diam., dull reddish brown, often surrounded by a dark, raised marginal line. Caespituli epiphyllous. Mycelium internal, stromata absent or small, brownish, 10-25 μm diam. Conidiophores densely fasciculate, emerging through stomata, subcylindrical to moderately geniculate-sinuous, 10-40 x 3-6 μm , 0-1-septate, olivaceous, conidial scars hardly thickened, somewhat darkened. Conidia solitary, obclavate-cylindrical, 0-5-septate, subhyaline to pale olivaceous, hila almost unthickened, somewhat darkened.

(4.6) *Passalora cercidicola* (Ell.) U. Braun comb. nov.

Fig. 10

Basionym: *Cercospora cercidicola* Ell., Amer. Nat. 16: 810 (1882).

Holotypus: on *Cercis canadensis*, USA, Lexington, Kansas, July 1888, Kellerman 44 (NY).

Description: Chupp (1954: 292).

Conidial scars slightly thickened and darkened, conidia broadly obclavate, usually 20-80 x 4-8 μm , 3-5-, mostly 3-septate, pale olivaceous. *C. cercidicola* is a typical *Passalora*.

(4.7) *Passalora circumcissa* (Sacc.) U. Braun comb. nov.

Fig. 11

Basionym: *Cercospora circumcissa* Sacc., Nuov. Giorn. bot. Ital. 8: 189 (1876).

Syn.: *Pseudocercospora circumcissa* (Sacc.) Guo & Liu, Mycosystema 2: 231 (1989).

Description: Chupp (1954: 473), Ellis (1976: 282).

Illustration: Ellis (1976: 282, fig. 214 B).

The conidial scars are hardly thickened, but darkened (*Passalora* type). The conidia are obclavate, 3-5-septate and yellowish brown. Type material not seen, but numerous other samples on *Prunus* s.lat. [e.g. Crypt. exs. 3622; Reliquiae Petrakianae 2146 (GZU); Rabenh., Fungi eur. 4091; Sacc., Myc. ven. 600 (HAL)].

(4.8) *Passalora comari* (Peck) U. Braun comb. nov. Fig. 12

Basionym: *Cercospora comari* Peck, Rep. N.Y. State Mus. nat. Hist. 38: 101 (1884).

Holotypus: on *Comarum palustre* (Rosaceae), USA, Karner, N.Y., July, Peck (NYS).

Description: Chupp (1954: 474), Ellis (1976: 281).

Illustration: Ellis (1976: 281, fig. 213 B).

This species is well-characterized by very long conidio-phores, up to about $300 \times 6 \mu\text{m}$, with almost unthickened, somewhat darkened conidial scars. The conidia are broadly obclavate, brownish, 1-5-septate. Hence, *C. comari* must be transferred to *Passalora*.

(4.9) *Passalora desmodii* (Ell. & Kellerm.) U. Braun comb. nov. Fig. 13

Basionym: *Cercospora desmodii* Ell. & Kellerm., Bull. Torrey bot. Club 11: 121 (1884).

Holotypus: on *Desmodium acuminatum* (Fabaceae), USA, Kansas, Manhattan, July 1884, Kellerman 585 (NY).

Description: Chupp (1954: 302).

Conidial scars hardly thickened, somewhat darkened; conidia obclavate (- cylindrical), subhyaline to faintly coloured, $3-9 \mu\text{m}$ wide, mostly 3-septate.

(4.10) *Passalora dubia* (Riess) U. Braun comb. nov. Fig. 14

Basionym: *Ramularia dubia* Riess, Bot. Zeitung 12: 190 (1854). Hedwigia 1: pl. IV, fig. 9 (1854). In Klotzsch, Herb. viv. mycol., cent. XIX, No. 1882, Dresden 1854.

Syntypus: on *Atriplex patula* (Chenopodiaceae), Germany, near Kassel, 1853, Riess, Herb. viv. mycol. 1882 (HAL).

Syn.: *Cercospora chenopodii* Fres., Beitr. Mykol., p. 92 (1863). *Cercospora dubia* (Riess) Winter, Fungi eur., ed. nov., cent. 28, No. 2780, Dresden 1882, non *C. dubia* Speg. (1880). *Cercosporidium dubium* (Riess) Liu & Guo (1982: 95).

Description: Chupp (1954: 112), Ellis (1976: 248, sub *C. chenopodii*).

Illustration: Ellis (1976: 249, fig. 187 B), Liu & Guo (1982: 89, fig. 1/6).

Conidial scars slightly thickened and darkened; conidia broadly obclavate, $5-8 \mu\text{m}$ wide, mostly 1-4-septate, subhyaline. This species is a typical *Passalora*.

(4.11) *Passalora effusa* (Berk. & Curt.) U. Braun comb. nov. Fig. 15

Basionym: *Cladosporium effusum* Berk. & Curt., Grevillea 3: 106 (1875).

Syn.: *Cercospora effusa* (Berk. & Curt.) Ell., Journ. Mycol. 1: 53 (1885).

Description: Chupp (1954: 451, sub *C. polygonorum*), Deighton (1986: 637).

Illustration: Deighton (1986: 638, fig. 1, based on type material).

Deighton (1986) discussed the confused application of the name *C. effusa*, pointed out that it is synonymous with *C. polygonorum* Cooke and provided a complete list of synonyms. I compared type material of the synonymous *C. hydropiperis* (Thüm.) Speg. (Thüm., Myc. univ. 1087, on *Polygonum hydropiper*, HAL). The conidial scars are almost unthickened and only somewhat darkened (*Passalora* type). The sub-cylindrical conidia are straight to curved, $3-10 \mu\text{m}$ wide, subhyaline, pale olivaceous to olivaceous brown, septate. This species is a typical *Passalora*.

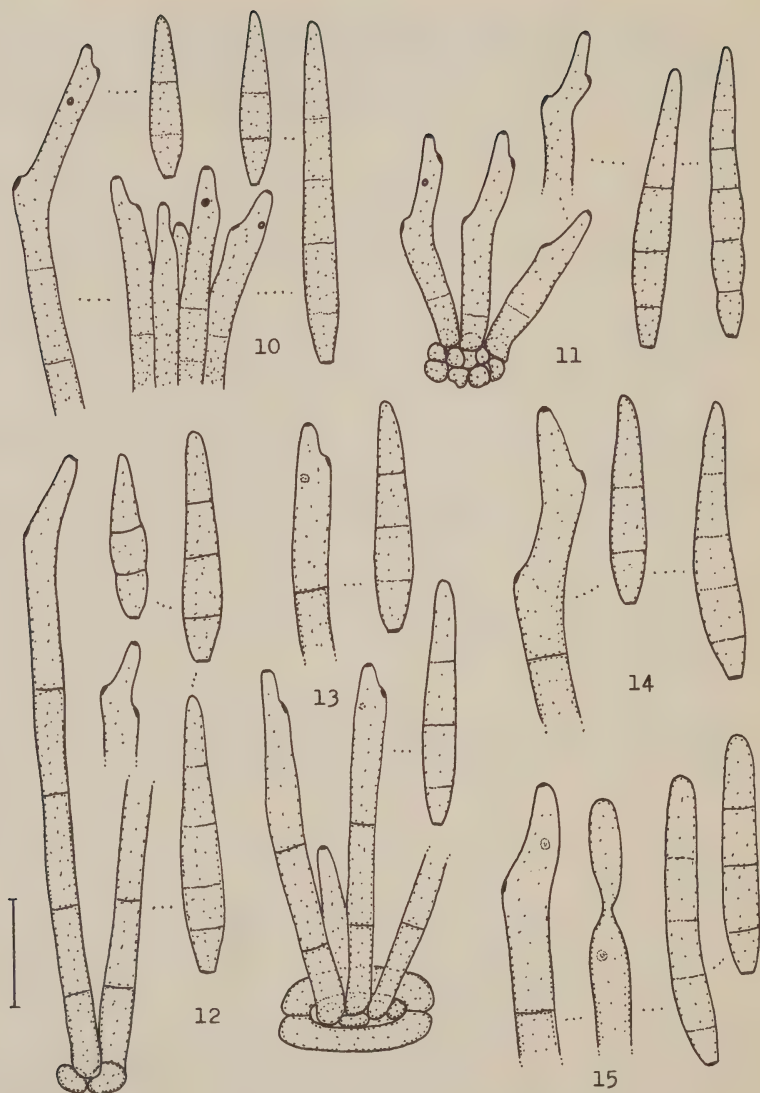


Fig. 10-15. Conidiophores, conidia, (10) *Passalora cerdicicola*, (11) *P. circumcissa*, (12) *P. comari*, (13) *P. desmodii*, (14) *P. dubia*, (15) *P. effusa*. Scale 20 μ m. U. Braun del.

(4.12) *Passalora flemingiae* (Liu & Guo) U. Braun comb. nov.
 Basionym: *Cercosporidium flemingiae* Liu & Guo, Acta Mycol. Sinica 1(2): 95-96 (1982).

Holotypus: on *Flemingia* spec. (Fabaceae), China, Emeishan, Sichuansheng, 25-10-1958, M. H. Song (HMAS 40609).

Illustration: Liu & Guo (1982: 96, fig. 5).

Liu and Guo (1982) described and depicted this species in detail. It is a typical *Passalora* with hardly thickened, but somewhat darkened conidial scars and obclavate conidia with 1-4 septa.

(4.13) *Passalora loranthincola* (Petrak) U. Braun comb. nov.
 Fig. 16

Basionym: *Cercospora loranthincola* Petrak, Sydowia 8: 220 (1954).

Syntypus: on *Loranthus pendulus* (Loranthaceae), Australia, Victoria, Gramplans, 25-3-1953, Gauba, Reliquiae Petrankianae 945 (GZU).

Leaf spots amphigenous, subcircular to angular, irregular, lax, 0.5-3 mm diam. Caespituli amphigenous, dark brown, dense, punctiform. Mycelium internal, forming well-developed stromata, intraepidermal, about 40-150 μ m diam., somewhat erumpent, olivaceous brown. Conidiophores in very rich, dense fascicles, sporodochial, arising from stromata, straight, subcylindrical to slightly geniculate-sinuous, 10-25 (-35) x 3-6 μ m, continuous, olivaceous, conidial scars hardly thickened, somewhat darkened. Conidia solitary, obclavate-cylindrical, 12-45 x 3-5 μ m, usually 0-3-septate, pale olivaceous or yellowish brown, hila hardly thickened, but somewhat darkened.

(4.14) *Passalora microsora* (Sacc.) U. Braun comb. nov.

Fig. 17

Basionym: *Cercospora microsora* Sacc., Michelia 2: 128 (1880).

Description: Chupp (1954: 564), Ellis (1976: 290).

Illustration: Ellis (1976: 289, fig. 219 D).

Conidial scars only slightly thickened and darkened, conidia obclavate-cylindrical, pale olivaceous, 1-8-, mostly 2-4-septate. On account of the slightly thickened conidial scars and coloured, more or less obclavate conidia, *C. microsora* must be placed in *Passalora*. Type material has not been examined, but numerous other specimens (e.g. Petrak, Myc. gen. 1731; Krieger, Fungi sax. 941, 942; Briosi & Cav., Funghi paras. 44; Rabenh., Fungi eur. 2781; Syd., Myc. germ. 192, on *Tilia* spec. div., GZU, HAL).

(4.15) *Passalora rhamni* (Fuckel) U. Braun comb. nov. Fig. 18
 Basionym: *Cercospora rhamni* Fuckel, Hedwigia 5: 24 (1866).

Syntypus: on *Rhamnus cathartica* (Rhamnaceae), Germany, Darmstadt, Fuckel, Fungi rhen. 1520 (HAL).

Description: Chupp (1954: 470).

The conidial scars are conspicuous, somewhat darkened, but almost unthickened (*Passalora* type). The conidia are obclavate to subcylindrical-fusiform, pale olivaceous, 4-7 μ m wide, 1-9-septate.

(4.16) *Passalora rosae* (Fuckel) U. Braun comb. nov. Fig. 19
 Basionym: *Exosporium rosae* Fuckel, Jahrb. Nass. Ver. Naturk. 23-24: 373 (1870).

Syntypus: on *Rosa alpina* (Rosaceae), Jura, Morthier, Fuckel, Fungi rhen. 1658 (HAL).

Syn.: *Cercospora rosae* (Fuckel) v. Höhnelt, Ann. Mycol. 1: 412 (1903).

Description: Chupp (1954: 485).

Illustration: Chupp (1954: 485, fig. 174).

Conidial scars not very conspicuous, hardly thickened, but somewhat darkened; conidia mostly 15-50 x 2-4 μ m, sub-cylindrical, usually attenuated towards the apex, sub-hyaline, (0-) 1-3 (-5)-septate. Because of the structure of the conidial scars and the small conidia with few septa, this species represents a typical *Passalora*.

(4.17) *Passalora rosicola* (Passerini) U. Braun comb. nov.

Fig. 20

Basionym: *Cercospora rosicola* Passerini, in Thüm., Herb. mycol. oec., Fasc. VII, No. 333, Bayreuth 1875 (with description!).

Syntypus: on *Rosa spec. cult.* (Rosaceae), Italy, Parma, 1874, Passerini, Thüm., Myc. univ. 1086 (HAL).

Description: Chupp (1954: 486).

Illustration: Chupp (1954: 485, fig. 175).

C. rosicola must be placed in *Passalora*. The conidial scars are only slightly thickened, somewhat darkened, and the conidia are obclavate, olivaceous, 1-4-septate.

(4.18) *Passalora rubro-tincta* (Ell. & Ev.) U. Braun comb. nov.

Fig. 21

Basionym: *Cercospora rubro-tincta* Ell. & Ev., Journ. Mycol. 3: 20 (1887).

Holotypus: on *Prunus persica* (Rosaceae), USA, Port a la Hache, La., 6-11-1886, Langlois (NY).

Description: Chupp (1954: 488), Ellis (1976: 283).

Illustration: Ellis (1976: 282, fig. 214 C).

Conidial scars somewhat thickened and darkened (*Passalora* type); conidia obclavate, 20-50 x 2-6 μ m, mostly 2-3-septate, pale olivaceous brown. This species is a typical *Passalora*.

(4.19) *Passalora simulans* (Ell. & Kellerm.) U. Braun comb. nov.

Fig. 22

Basionym: *Cercospora simulans* Ell. & Kellerm., Journ. Mycol. 8: 14 (1902).

Holotypus: on *Amphicarpaea monoica* (Fabaceae), USA, Gauley Mts., W. Va., Aug. 1901, Kellerman (NY).

Syn.: *Cercosporidium simulans* (Ell. & Kellerm.) Guo & Liu (1982: 100).

Description: Chupp (1954: 331).

Illustration: Liu & Guo (1982: 90, fig. 2/6).

Conidial scars somewhat thickened and darkened; conidia broadly obclavate-cylindrical (-fusiform), 10-60 x 4-8 (-9) μ m, 1-5-septate, subhyaline.

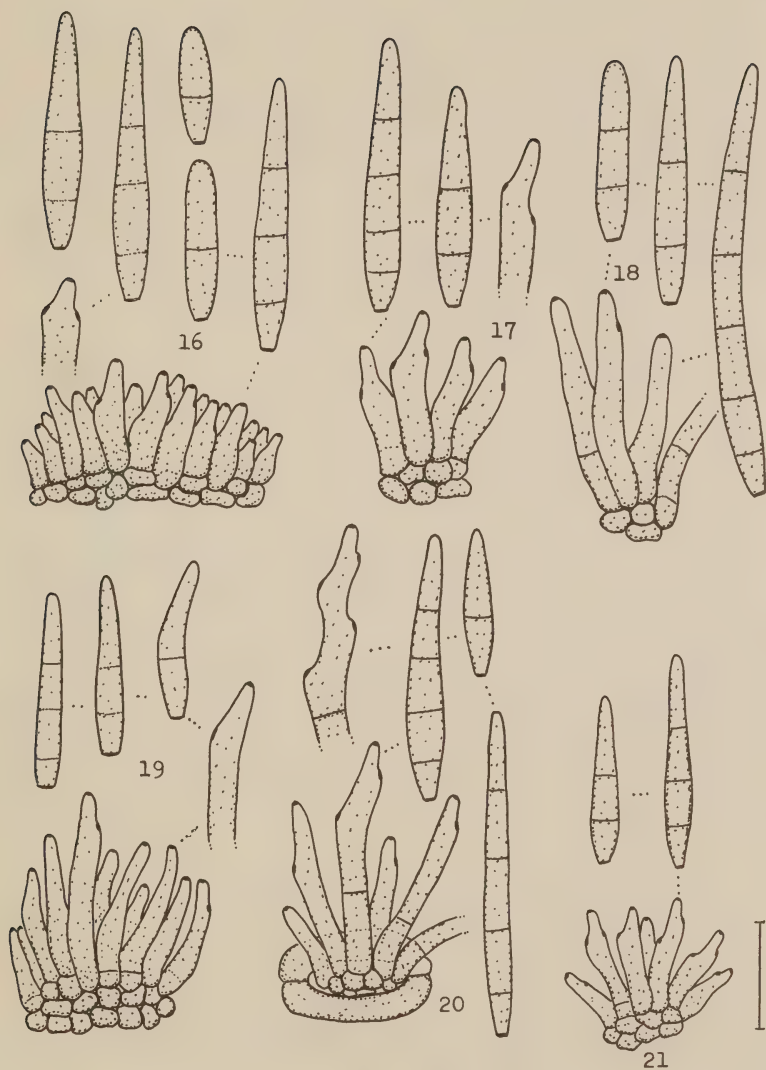


Fig. 16-21. Conidiophores, conidia, (16) *Passalora loranthincola*, (17) *P. microsora*, (18) *P. rhamni*, (19) *P. rosae*, (20) *P. rosicola*, (21) *P. rubro-tincta*. Scale 20 μm . U. Braun del.

(4.20) *Passalora stylosanthis* (Speg.) U. Braun comb. nov.

Fig. 23

Basionym: *Cercospora stylosanthis* Speg., Anal. Soc. Scient. Argent. 16: 169 (1883).

Description: Chupp (1954: 335).

This species is well-characterized by conidiophores in rich, dense fascicles, arising from large stromata. The conidial scars are slightly thickened, darkened and the conidia are obclavate, $25-80 \times 4-8 \mu\text{m}$, 2-6 (-7)-, mostly 3-5-septate, olivaceous to pale brown. Owing to these features, *C. stylosanthis* must be placed in *Passalora*. Type material could not be compared, but an agreeing collection from Africa was examined (on *Stylosanthes mucronata*, N. Rhodesia, Isoka, A. Angus, M 1043, ex herb. IMI 89770, GZU).

(5) *Phaeoramularia* Muntañola

(5.1) *Phaeoramularia ahmadii* (Petrak) U. Braun comb. nov.

Fig. 24

Basionym: *Cercospora ahmadii* Petrak, Sydowia 9: 495 (1955).

Syntypus: on *Marsdenia roylei* (Asclepiadaceae), Pakistan, Islamabad, Murree, 22-9-1949, S. Ahmad, Reliquiae Petrakianae 2544 (GZU).

Leaf spots amphigenous, almost absent to angular-irregular, often vein-limited, 1-6 mm diam., pale greenish to dull brown. Caespituli hypophyllous, punctiform, dark. Mycelium internal, forming well-developed stromata, $15-50 \mu\text{m}$ diam., olivaceous brown, cells $3-6 \mu\text{m}$ diam. Conidiophores in fairly dense to divergent fascicles, arising from stromata, straight, subcylindrical to somewhat geniculate-sinuous, $20-40$ (-65) $\times$ $3-6.5 \mu\text{m}$, 0-1 (-3)-septate, olivaceous, conidial scars thickened and darkened. Conidia in short chains, subcylindrical (-obclavate), $10-50$ (-70) $\times$ $3-6.5 \mu\text{m}$, 0-5-septate, pale olivaceous, hila slightly thickened and darkened.

The fasciculate conidiophores are provided with thickened, darkened conidial scars and the cylindrical (-obclavate) conidia are formed in chains. Hence, *C. ahmadii* belongs to *Phaeoramularia*.

(6) *Pseudocercospora* Speg. emend. Deighton

(6.1) *Pseudocercospora caloloma* (Petrak) U. Braun comb. nov.

Fig. 25

Basionym: *Cercospora caloloma* Petrak, Sydowia 4: 569 (1950).

Syntypus: on *Eurya nervosa* (Theaceae), Ecuador, Prov. Tungurahua, Hacienda San Antonio, near Baños, 10-12-1937, H. Sydow, Reliquiae Petrakianae 1347 (GZU).

Description: Chupp (1954: 560).

Leaf spots subcircular to angular, large, up to 25 mm diam., yellowish green to greyish brown, margin narrow, dull violet. Caespituli hypophyllous, punctiform, dark. Mycelium internal, forming large, brown stromata, up to $100 \mu\text{m}$ diam. Conidiophores in dense, rich fascicles, arising from stromata, subcylindrical, straight to slightly geniculate-sinuous, $10-100 \times 4-7 \mu\text{m}$, continuous to septate, brownish, smooth, conidial scars inconspicuous, unthickened. Conidia solitary,

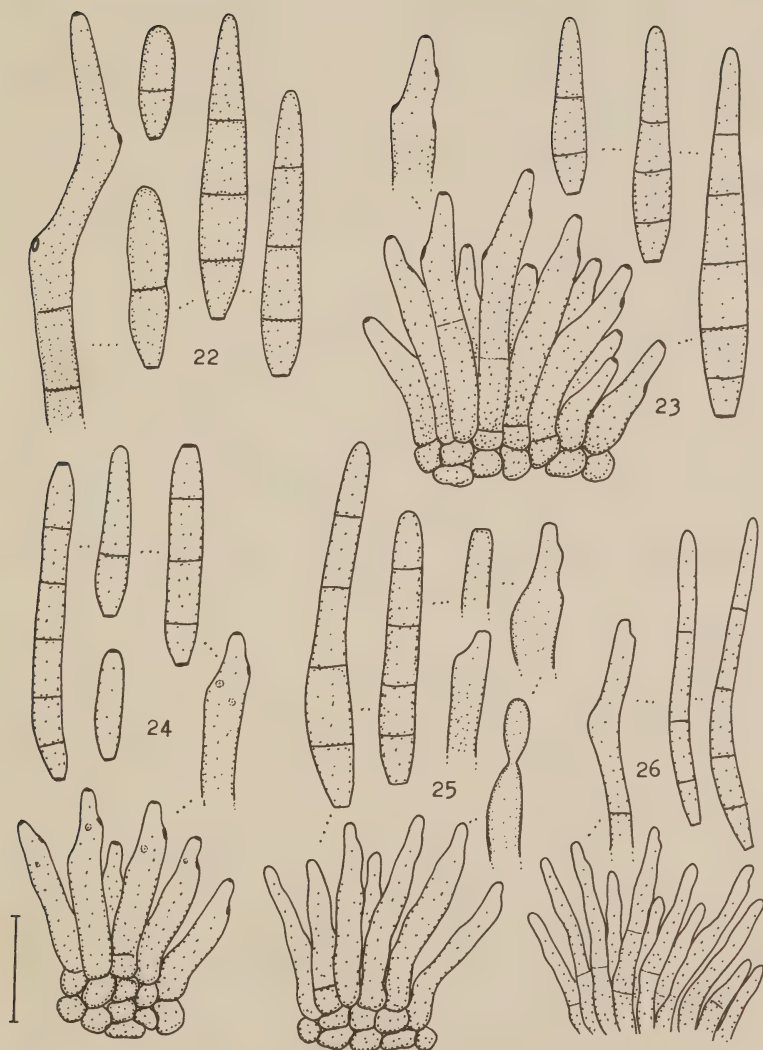


Fig. 22-26. Conidiophores, conidia, (22) *Passalora simulans*, (23) *P. stylosanthis*, (24) *Phaeoramularia ahmadii*, (25) *Pseudocercospora caloloma*, (26) *P. hedyosmi*. Scale 20 μm . U. Braun del.

obclavate-cylindrical, 25-125 x 5-7.5 μm , subhyaline to pale olivaceous brown, 2-9-septate, smooth, apex obtuse, base obconically truncate.

Because of the inconspicuous, unthickened conidial scars, this species must be referred to *Pseudocercospora*.

(6.2) *Pseudocercospora hedyosmi* (Petrak) U. Braun comb. nov.

Fig. 26

Basionym: *Cercospora hedyosmi* Petrak, Sydowia 4: 571 (1950).

Syntypus: on *Hedyosmum pavonii* (Chloranthaceae), Ecuador, Baños, Hacienda San Antonio, 9-1-1938, H. Sydow, Reliquiae Petrakianae 944 (GZU).

Description: Chupp (1954: 113).

Leaf spots amphigenous, subcircular to irregular, yellowish to reddish brown, 3-12 mm diam. Caespituli usually epiphyllous, punctiform, dark. Mycelium internal, forming large, brownish stromata, 30-70 μm diam. Conidiophores in rich, dense fascicles, arising from stromata, flexuous, subcylindrical to geniculate-sinuous, simple, rarely branched, 40-90 x 3-6 μm , continuous to septate, pale olivaceous brown, conidial scars inconspicuous, unthickened. Conidia solitary, acicular to narrowly obclavate-cylindrical, 35-65 x 3.5-5 μm , 3-5-septate, subhyaline to pale olivaceous.

Owing to inconspicuous, unthickened conidial scars, this species must be placed in *Pseudocercospora*.

(7) *Ramularia* Unger

(7.1) *Ramularia hyperici* U. Braun & Ch. Scheuer spec. nov.

Fig. 27

Maculae amphigenae, angulares-irregulares, oblongae, interdum per venas limitatae, 1-10 μm latae, brunneae, interdum confluentes. Caespituli hypophylli, disseminati, punctiformes, albidii. Mycelium immersum: hyphae hyalinae, septatae, ramosae. Stromata minuta vel bene evoluta, substomatalia vel intraepidermalia, 10-50 μm diam., hyalina, ex hyphis incoloribus, 2-5 μm latis, laxae intertextis, compositum. Conidiophora laxae fasciculata, saepe numerosa, per stoma emergentia vel erumpentia, subcylindrica, recta vel geniculata-sinuosa, simplicia, 5-35 x (1-) 1.5-3.5 (-4.5) μm , hyalina, laevia, continua vel septata, cicatrices conidiales incrassatae, fuscae. Conidia catenata, anguste ellipsoidea-ovoidea, subcylindrica, (8-) 10-25 (-30) x (1.5-) 2-3.5 (-4.5) μm , 0-2 (-3), saepe 0-1 septata, hyalina, verruculosa, ad apicem obtusa vel attenuata, basi obtusa vel attenuata, lenissime incrassata, fusca.

Holotypus; on *Hypericum perforatum* L., Austria, Steiermark, Grazer Bergland, Schöcklgebiet, Aufstieg zum Novy-stein, 700-890 m, 16-8-1992, P. Zwetko and Ch. Scheuer (GZU).

Leaf spots amphigenous, angular-irregular to oblong, sometimes vein-limited, 1-10 mm diam., brown, paler on the lower surface, margin indefinite, occasionally confluent, forming large brown patches, sometimes large leaf segments or almost entire leaves necrotic, yellowish to brown. Caespituli hypophyllous, scattered, punctiform, whitish. Mycelium

internal, hyphae hyaline, septate, branched, forming small to well-developed stromata, substomatal to intraepidermal, 10-50 μm diam., hyaline, composed of swollen hyphae, 2-5 μm diam. Conidiophores usually numerous, in fairly rich fascicles, mostly loose, divergent, arising from stromata, through stomata or erumpent through the cuticle, straight, subcylindrical to geniculate-sinuous, simple, 5-35 x (1-) 1.5-3.5 (-4.5) μm , hyaline, smooth, continuous to sparsely septate, conidial scars somewhat thickened and darkened. Conidia catenate, narrowly ellipsoid-ovoid to subcylindrical, (8-) 10-25 (-30) x (1.5-) 2-3.5 (-4.5) μm , 0-2 (-3)-, usually 0-1-septate, hyaline, verruculose, ends obtuse or attenuated, hila very slightly thickened, somewhat darkened.

Ramularia minutissima (Syd.) U. Braun, known from Europe on *Hypericum quadrangulum*, is distinguished by smaller, aseptate, solitary conidia.

(9) *Stenella* Syd.

(9.1) *Stenella diospyri* (Thüm.) U. Braun comb. nov. Fig. 28
 Basionym: *Cercospora diospyri* Thüm., Myc. univ., cent. XIII, No. 1273, Klosterneuburg 1878.

Syntypus: on *Diospyros virginiana* (Ebenaceae), USA, Aiken, Carol., Ravenel, Thüm., Myc. univ. 1273 (HAL).

Syn.: *Sirosporium diospyri* (Thüm.) M. B. Ellis (1976: 301).

Description: Chupp (1954: 200), Ellis (1976: 301).

Illustration: Ellis (1976: 300, fig. 225 D).

C. diospyri is a *Mycovellosiella*-like species with conidiophores in dense, rich fascicles and solitary, arising from superficial hyphae. The creeping secondary hyphae are, however, conspicuously verruculose. Hence, *C. diospyri* must be referred to *Stenella*. The conidiophores are thin-walled and the obclavate conidia are not *Sirosporium*-like (walls thin, septa only transverse).

(9.2) *Stenella litseae-glutinosae* (H. & P. Sydow) U. Braun comb. nov. Fig. 29

Basionym: *Cercospora litseae-glutinosae* H. & P. Sydow, Philipp. Journ. Sci. (Bot.) 8: 283 (1913).

Holotypus: on *Litsea glutinosa* (Lauraceae), Philippines, Luzon, Los Baños, 7-1-1913, Merrill, Baker 639 (S).

Description: Chupp (1954: 275).

Leaf spots amphigenous, subcircular to slightly angular, 0.5-10 μm diam., dark, dull brown, later centre pale, margin very dark, almost black, sometimes dark purplish-violet. Colonies hypophyllous, effuse. Primary mycelium internal, secondary mycelium external, hyphae creeping, 1.5-5 μm diam., pale olivaceous to brownish, septate, branched, verruculose. Stromata absent. Conidiophores solitary, lateral branches of creeping hyphae, subcylindrical, straight, 10-35 x 3-5 μm , continuous, pale olivaceous, conidial scars slightly thickened and darkened. Conidia formed singly, cylindrical-obclavate, 20-70 x 3-5 μm , 1-8-septate, pale olivaceous, verruculose, apex rounded to subacute, base obconically truncate, hila very slightly thickened and darkened.

Because of the verruculose superficial hyphae, *C. lit-*

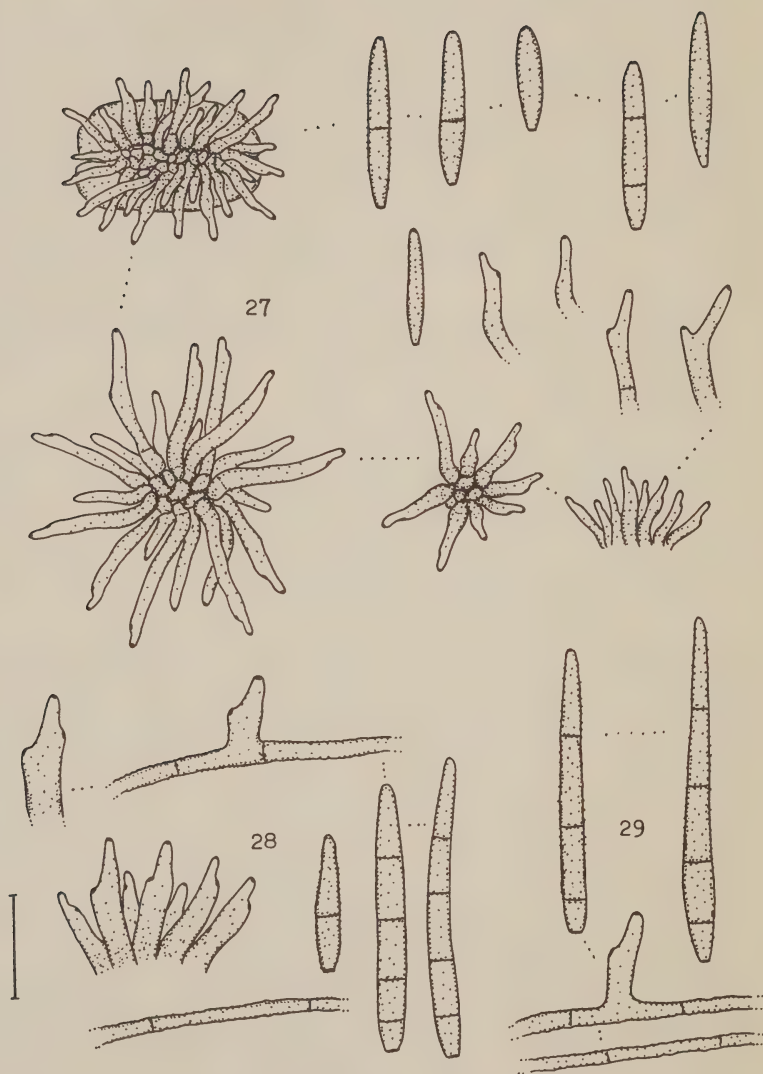


Fig. 27-29. Conidiophores, conidia, superficial hyphae, (27) *Ramularia hyperici*, (28) *Stenella diospyri*, (29) *Stenella litseae-glutinosae*. Scale 20 μm . U. Braun del.

seae-glutinosae must be placed in *Stenella*. I have examined additional material, distributed as Crypt. exs. 3298 (on *Litsea glutinosa*, Philippines, Prov. Rizae, Antipolo, 1927, Ramos, GZU).

Acknowledgements

Sincere thanks are due to the curators of the mentioned herbaria for allowing me to examine material in their keeping.

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A COMPARATIVE TAXONOMICAL INVESTIGATION OF *USTILENTYLOMA* *PLEUROPOGONIS* AND *U. FLUITANS* (USTILAGINALES)

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ABSTRACT

The morphometrical variability of ustilospores of *Ustilentyloma pleuropogonis* Savile and *U. fluitans* (Liro) Vánky is studied. *U. fluitans* on *Glyceria plicata* is reported as new to Balkan Peninsula. The other known unpowdery smut on *Glyceria* - *Entyloma dactylidis* (Pass.) Cif. in fact has the characters of *Melanotaenium*. A new combination *Melanotaenium dactylidis* (Pass.) Denchev is proposed.

INTRODUCTION

Examination of grass host specimens in SOM have yielded a new smut fungus to the Balkans - *Ustilentyloma fluitans* (Liro) Vánky.

Savile (in Savile & Parmelee, 1964) erected a new genus for a species like *Entyloma* but with germination of *Ustilago* type, viz. *Ustilentyloma pleuropogonis*. Vánky (1970, 1991) proposed new combinations and added two species to this genus: *U. fluitans* and *U. brefeldii* (Krieger) Vánky. *U. pleuropogonis* is known from Canada and Greenland (Savile & Parmelee, l. c.), and *U. fluitans* from Finland, Sweden, Germany, Hungary, Slovakia and Romania (Liro, 1935, 1938; Scholz & Scholz, 1988; Vánky, 1970, 1980, 1985a, b, 1987a), as well as the present new record from Bulgaria. *U. brefeldii* is distributed in Europe.

The objective of this paper is to characterize and illustrate morphometrical variability of ustilospores of *U. fluitans* and *U. pleuropogonis*.

MATERIAL AND METHODS

Specimens from BP, DAOM, H, HUV, M, S and SOM have been investigated in lactophenol (heated to boiling point and then cooled) by oil immersion at x 1250 magnification. Measurements of ustilospores are given in the form (smallest observed-) mean $\pm$ 1 standard deviation (-largest observed); N=100 in each collection.

A linear graphic presentation of the statistical parameters is used. The samples are not discrete and the variability is continuous if there is graphic overlapping in the $M \pm 1\sigma$ areas with respect to the character investigated. On the basis of the variation coefficients (V) the following scale for evaluating the metric variability of the ustilospores is used: reduced

degree ($V \leq 5\%$), modal level ($V = 5.1 \div 10\%$), increased degree ($V = 10.1 \div 15\%$) and high degree ($V = 15.1 \div 30\%$) (Denchev 1993).

RESULTS AND DISCUSSION

Ustilentyloma pleuropogonis Savile, in Savile & Parmelee, *Canad. J. Bot.* 42: 708. 1964.

S o r i in the mesophyll of the leaves, forming on the surface elongate, scattered, light yellowish-brown 0.5 - 2mm long spots. **U s t i l o s p o r e s** in general outline broadly elliptical or irregularly polygonal, rarely orbicular to suborbicular, 10-21.5 x 8-15 μm , L/w = 1.22, hyaline; the exospore smooth.

S p e c i m e n s e x a m i n e d. - On *Pleuropogon sabinei* R. Br.: Canada, Franklin Distr., Queen Elizabeth Islands, Ellef Ringnes Island, 1.5 mi. SW of Isachsen, 78°46' N, 103°36' W, 15.07.1960, D.B.O. Savile, DAOM 92912 (Holotype), and the same locality, 28.07.1960, D.B.O. Savile, DAOM 92913 (Para- & Topotype) (Figs. 1-3); Greenland, Brønlund Fiord, Heilpria Land, Peary Land, 82°10' N, 31° W, 27.07.1949, K. Holmen, DAOM 92914 (Paratype).

Because all the three materials were very small (as also Savile, l.c. showed), I measured the topotype (DAOM 92913). I think the Figs. 1-3 are the first illustrations of *U. pleuropogonis* (see Savile, in Savile & Parmelee, 1964; Vánky, 1987b).

U. fluitans (Liro) Vánky, *Microbiologia* (Bucuresti), 1: 328. 1970.

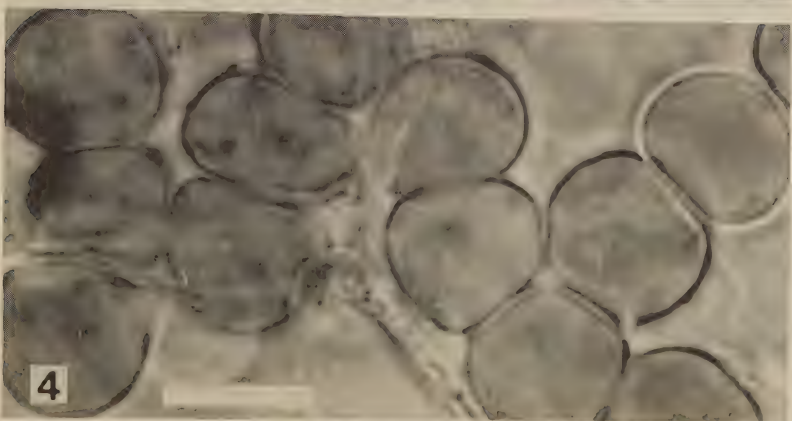
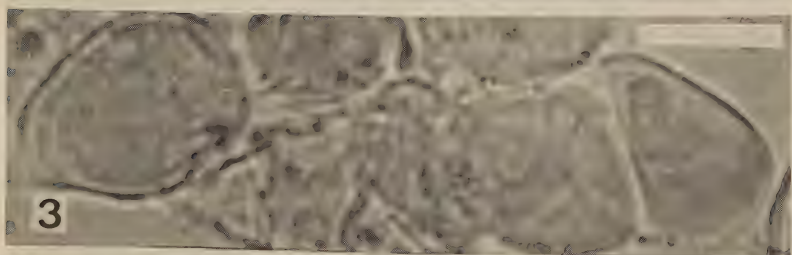
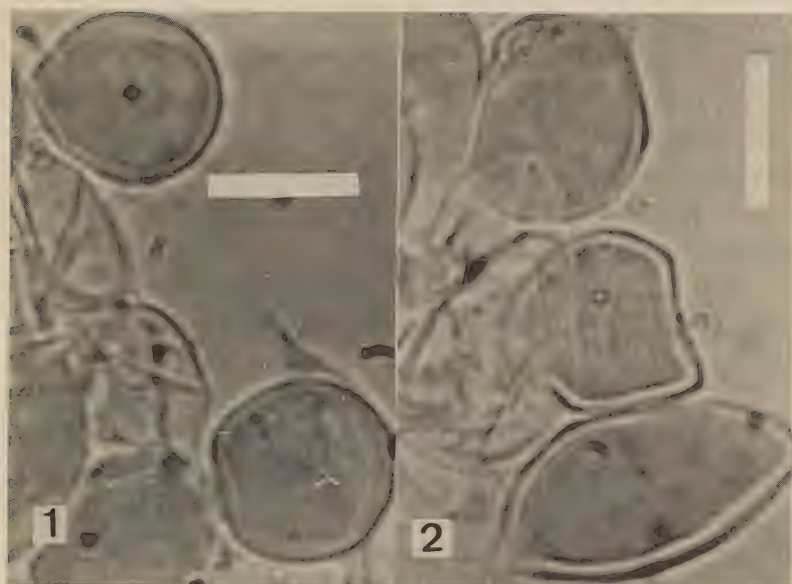
S o r i in the mesophyll of the leaves and leaf-sheaths, forming on the surface at first light yellow, later dark brown, linear or ovate, 1-10 mm long spots, often confluent. **U s t i l o s p o r e s** in general outline orbicular, suborbicular, ovate, broadly elliptical or slightly polygonal, $(7.5-) 11.7 \pm 1.2 (-17) \times (7-) 10.4 \pm 1.0 (-14) \mu\text{m}$, $N=1100$, $L/w = (1.09-) 1.12 (-1.16)$, hyaline or light yellow, wall c. $1 \mu\text{m}$ thick; the exospore smooth.

S p e c i m e n s e x a m i n e d . - On *Glyceria fluitans* (L.) R. Br.: Finland, Nyland, Pornainen, Kirkkonkyla, 09.08.1915, J.I. Liro, in Liro, Mycoth. fenn. 63, H (Isolectotype - Fig. 4; Lectotype in HUV); Finland, Sat., Vampula, Loimijoki, 29.06.1919, J.I. Liro, H: Sweden, Dalarna, pag. Gagnef, 28.09.1980, K. Vánky, BP 75582; Hungary, Vas Co, Szocse, 21.06.1983, J. Gönczöl, K. Imre, S. Tóth & K.Vánky, in Vánky, Ust. 500; Romania, Transsilvania, ad balneas Borsec, 12.07.1966, K. Vánky, in Vánky, Ust. 80; Romania, Transsilvania, Mt. Harghitei, Liban, alt. c. 1050 m s.m., 29.06.1980, Sz. & K. Vánky, S. On *Glyceria plicata* (Fr.) Fr.: Germany, Baden-Württemberg, pr. urbem Tübingen, Weilheim, $48^{\circ} 30' \text{ N}$, $9^{\circ} 02' \text{ E}$, alt. c. 350 m s.m., 16.09.1987, R. Bauer, A. Nagler & K. Vánky, in Vánky, Ust. 650; Slovakia, Mt. Velka Fatra, pr. pagum Blatnica, $48^{\circ} 58' \text{ N}$, $19^{\circ} 05' \text{ E}$, alt. c. 550 m s.m., 26.07.1978, J. Gönczöl, S. Tóth & K. Vánky, in Vánky, Ust. 325; Romania, Transsilvania, in alpinus Retezat, valle Jiul Rominesc, 13.07.1980, BP

Figs. 1-3. Ustilospores of *Ustilentyloma pleuropogonis* (paratype, DAOM 92913).

Fig. 4. Ustilospores of *U. fluitans* (isolectotype, H).

(Bars = $10 \mu\text{m}$).



75581; Romania, Transsilvania, distr. Harghita, Borsec, 800 m s.m., 04.07.1967, K. Vánky, in Herb. Mycol. Rom. 1970, M; Bulgaria, Regio Vitošae, Mt. Vitoša, prope coenobium Dragalevsky, 42°37' N, 23°18' E, alt. c. 1000 m s.m., 21.07.1932, B. Achtarov, SOM 20355-M.

The genus *Ustilentyloma* is new to Bulgaria and *U. fluitans* is new to the Balkans.

The basic statistical parameters of ustilospore length and width are shown in Table 1 and on bar diagrams (Figs. 5, 6).

The minimum values and means of length, as well as minimum and maximum values, and means of width of both species are not discrete and the variability is continuous. There is a discreteness regarding *max*-value of length only but the investigation of the frequency distribution within the variation serie of the length of *U. pleuropogonis* shows that few variants (incl. aberrants) cause a positive asymmetry. There is not a correlation between the *max*-values and the means of the length of these species. The variability of means $\pm 1\sigma$ is not discontinuous and in general the taxa are not discrete with respect to length and width. The variability of both characters is in *U. pleuropogonis* at an increased degree, and in *U. fluitans* at a modal level or increased degree (excl. the specimen BP 75581 - at a high degree).

Only the ranges were used in the keys to these two species in Karatygin & Azbukina (1989), and Vánky (1991). The ustilospores of *U. pleuropogonis* are mostly broadly elliptical or irregularly polygonal while these of *U. fluitans* are mostly orbicular, suborbicular, ovate to broadly elliptical. A character with good differentiating value is the length/width ratio (L/w) (Fig. 7).

Table 1: Morphometrical variability of the ustilospores of *Ustilentyloma pleuropogonis* and *U. fluitans*

Host, specimen	Length (µm)	V(%)	Width (µm)	V(%)	L/w
<i>Pleuropogon sabinei</i>					
DAOM 92913	(10-) 13.9±2.0	14.4	(8-) 11.4±1.3	(-15)	11.4 1.22
in Savile & Parmelee (1964)	11.5 -21		9 -14.5		
<i>Glyceria fluitans</i>					
Liro, Mycoth.fenn. 63	(9-) 11.1±0.9	8.1	(7.5-) 9.9±0.9	(-12.5)	9.1 1.12
H, 29.06.1919	(9-) 11.7±1.3	11.1	(8-) 10.3±1.1	(-12.5)	10.7 1.13
BP 75582	(9-) 12.3±1.4	11.4	(8-) 10.9±1.2	(-14)	11.0 1.13
Ványk, Ust. 500	(9-) 11.9±1.1	9.2	(8-) 11.0±1.0	(-13)	9.1 1.09
Ványk, Ust. 80	(10-) 11.6±0.9	7.7	(8-) 10.5±0.8	(-12.5)	7.6 1.10
S, 29.06.1980	(8-) 11.1±1.1	9.9	(8-) 9.8±0.8	(-11.5)	8.2 1.13
<i>Glyceria plicata</i>					
Ványk, Ust. 650	(9-) 11.7±1.2	10.3	(8-) 10.6±0.9	(-12.5)	8.5 1.10
Ványk, Ust. 325	(10.5-) 12.3±1.1	8.9	(8-) 11.2±1.1	(-13)	9.8 1.10
BP 75581	(7.5-) 11.7±2.0	17.1	(7-) 10.3±1.7	(-13)	16.5 1.13
Herb. Mycol. Rom. 1970	(10-) 11.3±1.1	9.7	(7.5-) 9.7±0.9	(-11.5)	9.3 1.16
SOM 20355 - M	(8-) 12.1±1.2	9.9	(8-) 10.7±1.0	(-14)	9.3 1.13
in Liro (1935)	8 - 12 (diam.)				
in Ványk (1985)	8.5 - 17		7.5 - 14		

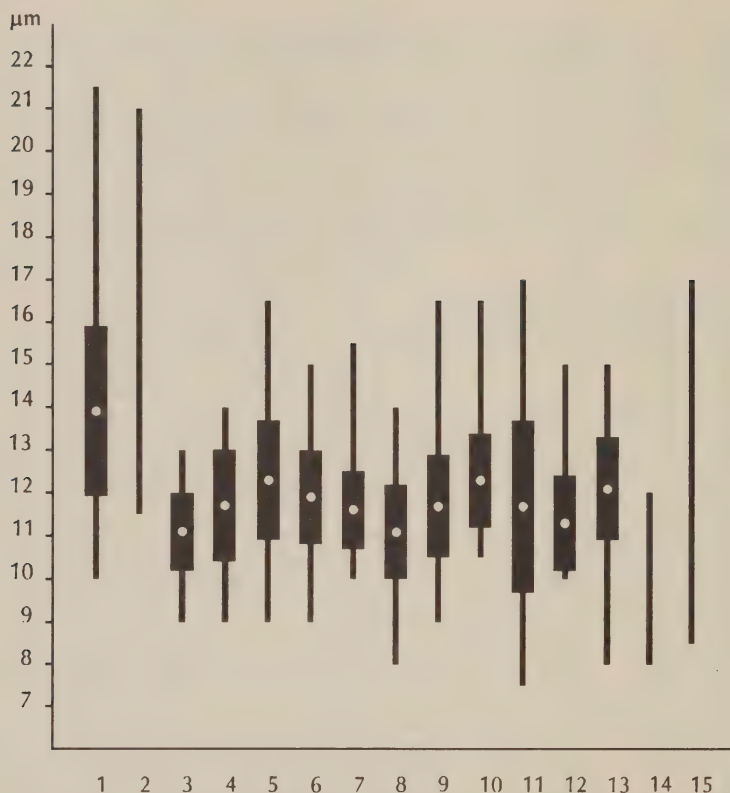


Fig. 5. Bar diagram for length of ustilospores. The specimens are arranged from north to south with respect to the geographical distribution using the order in Table 1.

Key to the known *Ustilentyloma* species

- 1 Spore wall thick (1.5-3 µm). On different genera of Poaceae.....*U. brefeldii*
- 1* Spore wall thin (0.5-1 µm).....2
- 2 Spore length/width ratio ≤1.16. On *Glyceria*.....*U. fluitans*
- 2* Spore length/width ratio >1.20. On *Pleuropogon**U. pleuropogonis*

U. pleuropogonis also differs from *U. fluitans* in the sporidia measurements (see Savile, in Savile & Parmelee, 1964; Vánky, 1970).

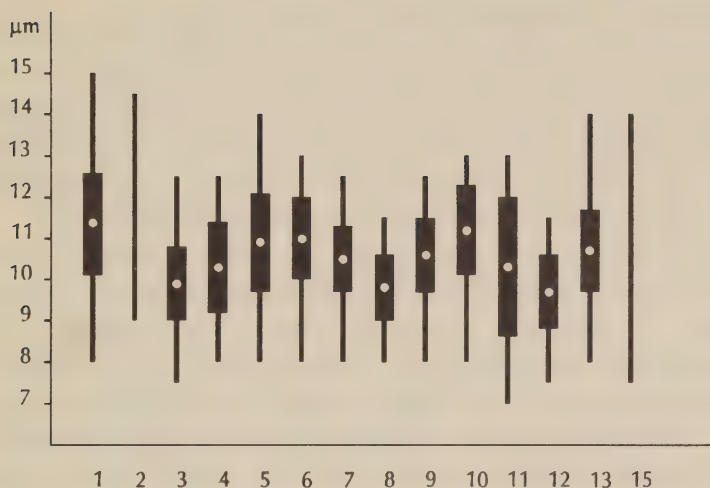


Fig. 6. Bar diagram for width of ustilospores (see the remark under the Fig. 5).

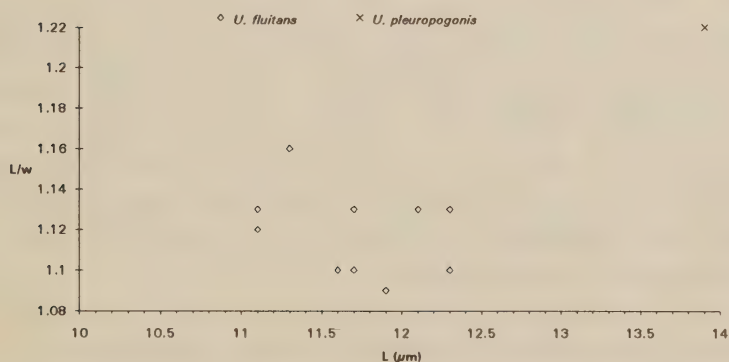


Fig. 7. Scatterplot showing the average length and length / width ratio of ustilospores of *U. pleuropogonis* and *U. fluitans*, based on the measurements in Table 1.

Fragoso (1924) described a new *Entyloma* on *Glyceria* which was later treated by Ciferri (1963) as *Protomycetales*. Among the materials from H I found an undeterminate specimen on *Glyceria aquatica* (L.) Walenb.: Finland, KI, Sortavala, Seminaarin,

01.08.1929, V. Heikinheimo, J. I. Liro. Today this locality is in Russia (Karelia). In 1972 the material was revised by P. Alanko as *Entyloma fluitans* Liro. The characters of the sorus and ustilospores were not typical of *Entyloma* and *Ustilentyloma*. This specimen was not a smut fungus [possibly immature spores of Hemiascomycetidae (?)].

Among the materials of *Ustilentyloma* from DAOM there were three specimens on *Glyceria striata* (Lam.) A. Hitchc.: Canada, Ont., Bear Island, L. Temagami, 21.08.1935, H. S. Jackson, DAOM 18765 [ustilospores (10.5-) 13.3 ± 1.3 (-16.5) x (9-) 11.3 ± 1.0 (-13) μm] and 79827 [both as *Entyloma crastophilum* Sacc. on *G. nervata* (Willd.) Trin.], and the same locality and coll., 22.08.1944, DAOM 41017 [(9-) 11.7 ± 1.2 (-15.5) x (8-) 10.1 ± 1.3 (-12.5) μm , as *Entyloma dactylidis* (Pass.) Cif.]. The fungus in these specimens is another known unpowdery smut on *Glyceria* - *Entyloma dactylidis*. In fact its position in *Entyloma* is very controversial. This taxon is characterized by sori forming black swellings and dark-coloured ustilospores as in *Melanotaenium* species. In *Entyloma* species the sori form light-coloured spots and the ustilospores are hyaline or light-coloured. I propose a new combination:

Melanotaenium dactylidis (Pass.) Denchev, *comb. nov.*

Basionym: *Thecaphora dactylidis* Pass., in Fisch. v. Waldh., *Apercu syst. Ust.* Paris, 34. 1877.

Synonym: *Entyloma dactylidis* (Pass.) Cif., *Bull. Soc. Bot. Ital.* 1924: 55. 1924.

ACKNOWLEDGEMENTS

I am grateful to the Directors and Curators of BP, DAOM, H, HUV, M and S for the loans of *Ustilentyloma* spp.

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NEW SPECIES OF KELLERMANIA, PIPTARTHRON,
PLANISTROMA, AND PLANISTROMELLA
FROM MEMBERS OF THE AGAVACEAE

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SUMMARY: Five new fungal species from hosts in the Agavaceae are described. *Kellermania nolinifoliorum* and *Planistroma nolinae* and its anamorph, *Piptarthron crassisporum* are from *Nolina* sp., *Piptarthron dasylirionis* is found on *Dasylirion* sp., and *Planistromella torsifoliorum*, the teleomorph of *Kellermania uniseptata* (= *Alpakesa uniseptata*), is from *Yucca rupicola*.

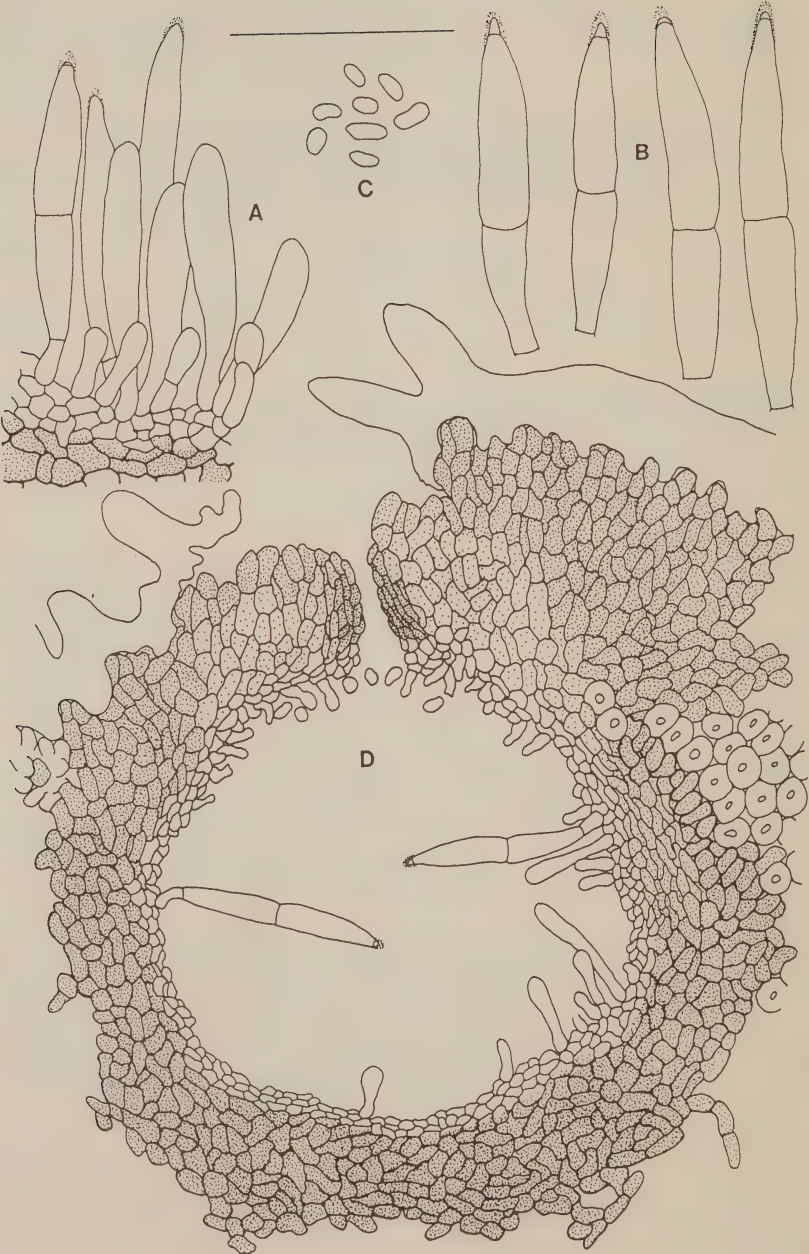
INTRODUCTION: *Piptarthron* and *Kellermania* are coelomycete genera with dark-brown to black, thick-walled, immersed, ostiolate conidiomata, holoblastic, determinate conidiogenous cells that each form a single acrogenous, large, hyaline, thin-walled conidium which lacks appendages in *Piptarthron* and bears appendages in *Kellermania*. The species of *Piptarthron* are separated by the size, shape, and septation of the conidia, and the number of locules in the conidiomata (3). The species of *Kellermania* are separated by the number of septa in the conidia, and the size and number of apical appendages (2, 5). The separation of the two genera on the basis of the presence or absence of an apical appendage is controversial (1, 6). Characters of the teleomorphs so far discovered support this separation as they are consistently different (3, 4, 5) in that ascospores of *Planistroma*, the teleomorph of *Piptarthron* are aseptate, while ascospores of *Planistromella*, the teleomorph for *Kellermania* are septate.

MATERIALS AND METHODS: Measurements are from living materials. Cultures from anamorphs were prepared by suspending conidia in a drop of sterile tap water on the surface of potato dextrose agar (PDA) in a petri plate and spreading the drop with a glass rod. After twenty four hours, single germinated conidia were placed on PDA. Cultures from teleomorphs were made by washing asci three times in sterile tap water and transferring individual asci to PDA in a petri plate. Cultures were maintained at room temperature on a table top.

TAXONOMY:

Kellermania nolinifoliorum A. W. Ramaley, sp. nov., Fig. 1, A-D.

Conidiomata brunnea, linearia, subepidermalia, immersa, plerumque uno latere



fissurae stomatis, transectio asymmetrica, 200-1600 μm longa, usque ad 260 μm lata, usque ad 350 μm elata, uni- vel plurilocularia, crassiparietibus. Paries ex texture angulari fusca compositus, pallidior versus partem interiorem. Loculi uniseriati, longisectio circa orbiculata, transectio ellipsoidea vel orbiculata, per columnas ex cellulis elongatis compositis separati, omnes ostiolo angusto. Ostiolum cellulis paucis atritunicatis cinctum, per fissens longitudinale epidermidis hospitis expositum, canalis ostiolum ca 12 μm latus. Conidiophora raro praesentia, brevia, unicellula. Cellulae macroconidiogenae in cellulis interioribus parietum loculorum formatae, holoblasticae, determinatae, discretae vel raro integratae, doliiformes, hyalinae, omnes conidium unum acrogenum formantes. Macroconidia hyalina, tenuitunicata, levia, (0-) 1 (-3)-septata, septum circa medium, plerumque aliquantum constricta septo, extremis decrescentia, apicibus acutis et appendicibus tegmenibus mucosis usque ad 5 μm longis superpositis, saepe partim muco base plus minusve truncata, 50-80 x 7.2-9.6 μm . Microconidia in pariete supero loculum et canale ostioli exorientia, prope globosa vel ellipsoidea vel subcylindracea, 4-9 x 3-5 μm .

HOLOTYPE: U.S.A. NEW MEXICO. Lincoln County, Valley of Fires, U. S. Hwy. 380, mile 59.25, roadside, *in foliis mortuis Nolina* sp., 23 May 1993, Annette Ramaley 9316A, BPI 802718. ISOTYPE: UC 1475133.

Conidiomata brown, linear, subepidermal, immersed, usually along only one side of a stomatal cleft, asymmetric in transection (Fig. 1, D), 200-1600 μm long, up to 260 μm wide, up to 350 μm tall, 1-several loculate, thick-walled. Wall composed of dark-brown *textura angularis*, lighter colored toward the interior. Locules in a single row, approximately circular in longisectio, ellipsoidal to circular in transection, each with a narrow ostiole, separated by columns of elongated cells. Ostiole surrounded by a few black-walled cells (Fig. 1, D), exposed by the longitudinal splitting of the epidermis, ostiolar channel ca 12 μm wide. Conidiophores rarely present, short, 1-celled. Macroconidiogenous cells (Fig. 1, A) formed from the inner cells of the locular walls, holoblastic, determinate, discrete or sometimes integrated, doliiform, hyaline, each producing a single acrogenous conidium. Macroconidia (Fig. 1, B) hyaline, thin-walled, smooth, (0-) 1 (-3)-septate, the septum approximately median, usually somewhat constricted at the septum, narrowing toward both ends, the apex acute with a small slime-covered appendage up to 5 μm long, often with some slime at the more or less truncate base, 50-80 x 7.2-9.6 μm . Microconidia (Fig. 1, C) formed at the top of the locule and in the ostiolar channel, nearly spherical to ellipsoidal to subcylindric, 4-9 x 3-5 μm .

Substrate: Dead leaves of *Nolina* sp.

Kellermania nolinifoliorum is the first species of the genus with multilocular conidiomata, a feature regularly, found in the the closely related genus, *Piptarthron*. The linear conidiomata parallel a fiber bundle and the stomatal

Fig. 1. *Kellermania nolinifoliorum*. A. Conidiogenesis. B. Macroconidia. C. Microconidia. D. Conidioma. Standard line: A-C=40 μm ; D=80 μm .

cleft that lies midway between two such fiber bundles. The fungus may gain access to the interior through stomata on the lateral walls of these clefts--hyphae extending through a stoma from an exterior mycelial mass to a developing conidioma have been observed. Conidiomata develop between the epidermal cells of the stomatal cleft and the fiber bundle. A 'lip' of cells forms between the upper or lower epidermis and the edge of a fiber bundle (Fig. 1, D). Conidiomata are, therefore, asymmetric in transection. If a conidioma develops on both sides of a stomatal cleft, it is symmetric and has two rows of locules.

The conidial appendage is formed as in other *Kellermania* species (2, 5). Conidial initials are bluntly rounded, but after considerable elongation the apex narrows. The tip may then be occluded forming the apical appendage. In *K. anomala* (Cooke) Höhn. and *K. yuccigena* Ellis and Everh., the single apical appendage is 12-32 μm long, while in *K. yuccifoliorum* A. W. Ramaley, which has 2-septate conidia and *K. nolinifoliorum*, which has 1-septate conidia, the maximum length of the appendage is 5 μm .

Planistroma nolinae A. W. Ramaley, *sp. nov.*, Fig. 3, E, F.

Stromata fusca, subepidermalia, immersa, amphigena, linearia, separata vel confluentia extremis, ubi separata (240-) 480-960 (-1440) x 200-530 μm , longiora ubi confluentia, usque ad 470 μm elata, 1-10-locularia; paries typice fusca et summe crassus basi, saepe pallidior et minus crassus latere uno vel utrinque. Stratum supremum stromatis ex columnis cellularum elongatarum compositum. Loculi ascogeni in eodem stromate ac loculi conidiogeni vel spermatigeni vel ambo exorientes, asci post conidia vel spermatia formati. Loculi unistrati, omnes ostiolati, per columnas cellulis luteis vel brunneis elongatis separati. Asci bitunicati, cylindriclavati, duo- ad octospori, 30-40 μm lati et ca 200 μm longi ante prolotionem ultimam et missionem ascosporarum. Ascosporae hyalinae, leniter obovatae vel ellipsoideae, aseptatae, 31.2-44 x 13.6-17.6. Cellulae interthecii filamentosae, abundae ubi asci vetissimi maturi, ab apice loculi versus imum fatiscentes.

HOLOTYPE: U.S.A. NEW MEXICO: Lincoln County, Valley of Fires, U. S. Hwy. 380, mile 59.25, roadside, in *foliis mortuis Nolina* sp., 23 May 1993, Annette Ramaley 9316B, BPI 802720.

Stromata dark brown, subepidermal, immersed, amphigenous, linear, separate or confluent at the ends, when separate (240-) 480-960 (-1440) x 200-530 μm , longer when confluent, up to 470 μm tall, 1-10-loculate; wall usually dark and very thick at the base, often lighter and thinner at one or both sides. The top of a stroma composed of columns of elongated cells. Ascogenous locules developing in the same stroma as conidial or spermatogenous locules or both, asci formed after the production of conidia or spermatia. Locules in a single layer, each with an ostiole, separated by columns of yellow to brown elongated cells. Asci (Fig. 3, F) bitunicate, cylindric-clavate, 2-8 spored, 30-40 μm wide and ca 200 μm long before the final elongation and ascospore release. Ascospores (Fig. 3, E) hyaline, slightly obovate to ellipsoid, aseptate, 31.2-44 x

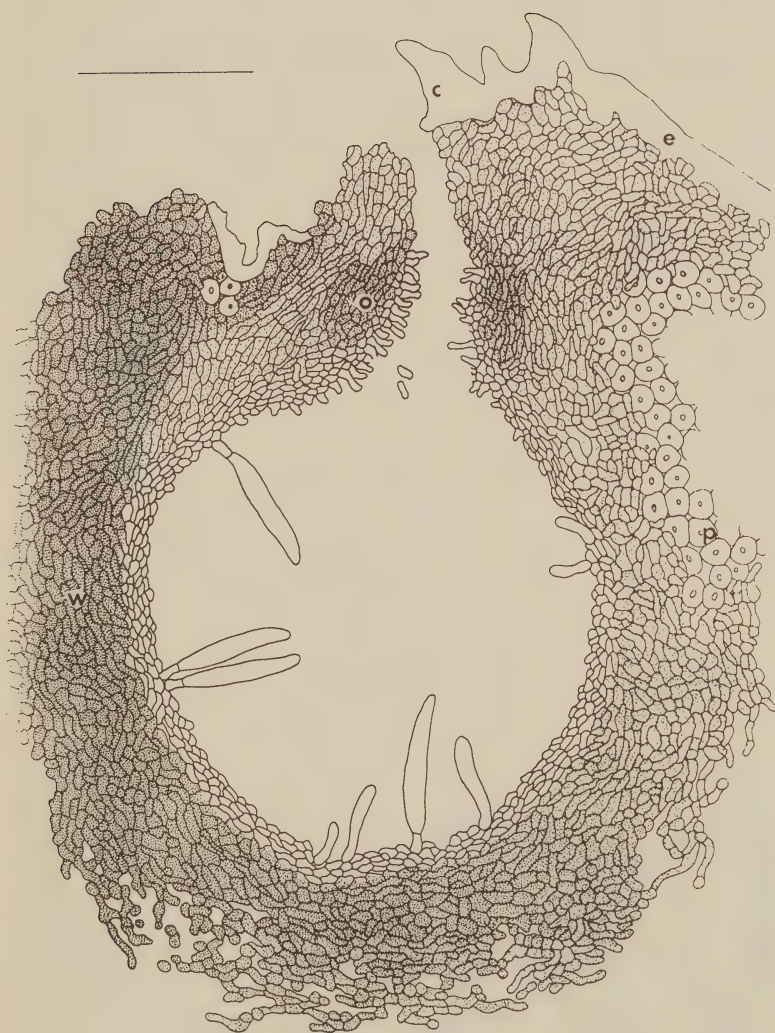
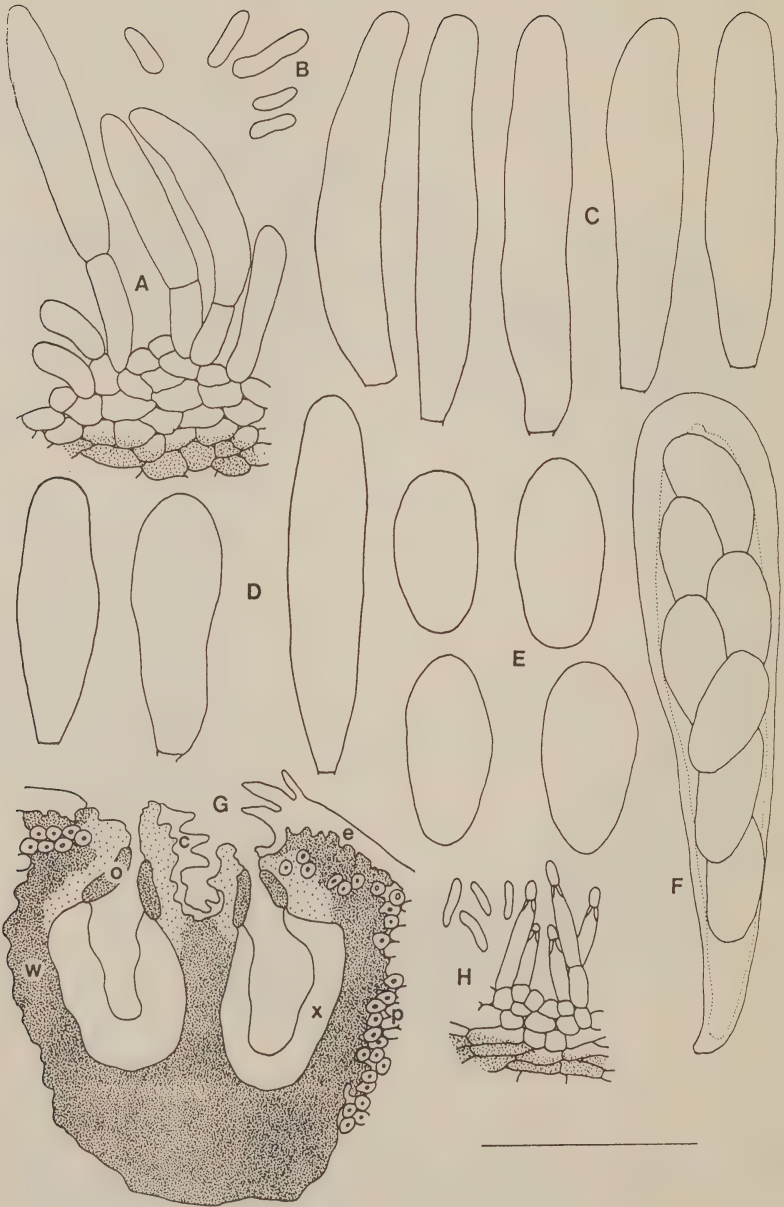


Fig. 2. *Piptarthron crassisorum*. Conidioma. e=host epidermis, c=host epidermis of stomatal cleft, p=transection of leaf fibers, o=dark-walled cells around ostiole, w=wall. Standard line=80 μ m.



13.6-17.6. Interthecial cells filamentous, abundant when the oldest asci are mature, breaking down at the top of the locule and proceeding downward.

Substrate: Dead leaves of *Nolina* sp.

Anamorph: *Piptarthron crassissporum* A. W. Ramaley, sp. nov. Figs. 2; 3, A-D, G, H.

Conidiomata subepidermalia, immersa, amphigena, linearia, separata vel confluentia, ubi separata (240-) 480-960 (-1440) x 200-530 µm, longiora ubi confluentia, usque ad 470 µm elata, plerumque 1-6-locularia; paries typice fusca et summe crassus basi, saepe pallidior et minus crassus latere uno vel utrinque. Stratum supremum stromatis ex columnis cellularum elongatarum compositum. Loculi unistrati, per columnas cellulis luteis vel brunneis elongatis separati, paries interior loculi ex 3-4 stratis cellularum hyalinarum compositus, ostiolati. Ostiolum cellulis atrotunicatis cinctum. Cellulae macroconidiogenae parietibus interioribus loculi formatae, brevicylindratae, hyalinae, leves, omnes conidium unum acrogenum formantes. Macroconidia cylindrata vel aliquantum attenuata apicibus obtuse rotundatis, aseptata, levia, hyalina, 56.8-78.4 x (10.4-) 12.8-14.4, $\bar{x}$ =67.5 x 12.9 µm. Cellulae microconidiogenae in canale ostioli et pariete supero loculi prope ostiolum formatae. Microconidia acrogena, plus minusve cylindrata, aseptata, levia, hyalina, plerumque 5-16 x 2.4-4 µm. Spermatia stromatibus discretis vel in eodem stromate ac conidia formata, loculis discretis vel in eodem loculo ac conidia formata, omnes loculi spermatigeni ostiolati. Cellulae spermatigenae discretae vel integratae conidiophoro unicellulari, cylindratae vel elongatae-conicae, leves, hyalinae, phialidicae, 16-20 x 2.4-3.2 µm. Spermatia bacillaria, hyalina, levia, 4.8-7.2 x 1.6-2.4 µm.

HOLOTYPE: U.S.A. NEW MEXICO: Lincoln County, Valley of Fires, U. S. Hwy. 380, mile 59.25, roadside, in foliis mortuis *Nolina* sp., 23 May 1993, Annette Ramaley 9316C. BPI 802717.

Conidiomata (Fig. 2) dark brown, subepidermal, immersed, amphigenous, linear, separate or confluent at the ends, when separate (240-) 480-960 (-1440) x 200-530 µm, longer when confluent, up to 470 µm tall, mostly 1-6-loculate; wall usually dark and very thick at the base, often lighter and thinner at one or both sides. The top of a stroma composed of columns of elongated cells. Locules in a single layer, separated by columns of yellow to brown, elongated cells, the inner wall of a locule composed of 2-4 layers of hyaline cells, ostiolate. Ostiole surrounded by very dark-walled cells. Macroconidiogenous cells (Fig. 3, A) on the inner wall of a locule short-cylindric, hyaline, smooth, each forming a single

Fig. 3. A-D, G, H, *Piptarthron crassissporum*. A. Conidiogenesis. B. Microconidia. C. Macroconidia from nature. D. Macroconidia from culture. G. Spermatogenous locules. e=host epidermis, c=host epidermis of stomatal cleft, p=transsection of leaf fibers, o=dark-walled cells around ostiole, w=wall, x=region of spermatogenesis. H. Spermatogenesis and spermatia. E, F, *Planistroma nolinae*. E. Ascospores. F. Ascus. Standard line: A-E, H=40 µm; F=50 µm; G=240 µm.

acrogenous conidium. Macroconidia (Fig. 3, C) cylindric to somewhat tapered toward the bluntly rounded apex, aseptate, smooth, hyaline, $56.8-78.4 \times (10.4-12.8-14.4)$, $\bar{x}=67.5 \times 12.9 \mu\text{m}$. Microconidiogenous cells in the ostiolar channel and on the upper wall near the ostiole. Microconidia (Fig. 3, B) acrogenous, more or less cylindric, aseptate, smooth, hyaline, mostly $5-16 \times 2.4-4 \mu\text{m}$. Spermatia (Fig. 3, H) formed in separate stromata (Fig. 3, G) or in the same stroma with conidia, in separate locules or in the same locule with conidia, each spermatial locule ostiolate. Spermatogenous cells discrete or integrated on a one-celled (usually) conidiophore, cylindric to elongate-conical, smooth, hyaline, phialidic, $16-20 \times 2.4-3.2 \mu\text{m}$. Spermatia bacillar, hyaline, smooth, $4.8-7.2 \times 1.6-2.4 \mu\text{m}$.

Substrate: Dead leaves of *Nolina* sp.

Ascospores and conidia germinated readily. When transferred, the germlings grew very slowly, sometimes requiring 2-3 weeks to grow from the small transfer block into the fresh agar. Colonies then grew slowly but steadily. Colonies white or pink above, the reverse usually pink, darkening with age. Conidiomata dark, multilocular, immersed in the mycelium but the top usually exposed. Conidia hyaline, smooth, generally less regularly cylindric than conidia formed in nature (Fig. 3, C, D), aseptate, the apices bluntly rounded and the bases more or less truncate. The slow growth after germination, the colonies, and the conidia were essentially identical for cultures from conidia of *Piptarthron crassisporum* and cultures derived from ascospores of *Planistroma nolinae*. It was therefore concluded that the two species are a part of the same holomorph.

Ascospores of *Planistroma nolinae* are larger than those from *P. yuccigena* A. W. Ramaley (3), the other published species whose anamorph also has aseptate conidia. However, observation of many collections has shown that ascospores produced by the teleomorphs of several distinct anamorphs (unpublished) are very similar in size and shape to those of *P. nolinae*. Therefore, ascospore size alone cannot be used to separate *P. nolinae* from other species having anamorphs with aseptate conidia.

Piptarthron crassisporum forms linear conidiomata in the parenchyma between fiber bundles running the length of the leaf. The stromata may be symmetric about the stomatal cleft midway between two fiber bundles, or mostly on one side of such a cleft, the other side having only a 'lip' of stomatal cells. If the stroma is on only one side of a cleft, it contains a single row of locules; if the stroma is symmetric about the cleft, it contains two rows of locules.

Piptarthron specimens with aseptate conidia are generally difficult to separate into species. Collections from different plant species or localities may seem distinct, but often, when compared to other collections, there is intergradation of conidium dimensions, a major distinguishing character. No average length or width was published for the conidia of *Piptarthron yuccae* (Ellis and Everh.) Sutton (1). Assuming those averages lie approximately midway between the minimum and maximum length and width, the average length/average width

quotient (L/W) for that species is approximately 19.4. The L/W for *Piptarthron pluriloculare* A. W. Ramaley is 10.4, and for *P. crassissporum*, 5.2. *P. crassissporum* is separated from these other species with aseptate conidia by the relative width of the conidia as well as the blunt conidial apex. The slow growth of germinated conidia is also characteristic of *P. crassissporum*, though not ascertainable in old collections.

Piptarthron dasytirionis A. W. Ramaley, *sp. nov.*, Fig. 4, A-F.

Conidiomata amphigena, subepidermalia, fusca vel atra, immersa, linearia, plerumque 250-1150 µm longa, 210-550 µm lata, usque ad 400 µm elata, superficie superna plana, multilocularia. Parietis cupulatus, in epidermide hospitis affixus, ex stratis pluribus cellularum fuscis vel atris crassitunicatarum compositus, pallidus versus partem internam. Stratum supremum conidiomatis ex columnis cellularum aurearum elongatarum compositum. Loculi omnes uniostiolati, canalibus ostioli cellulis atritunicatis cinctus, per disrumpentem epidermidis hospitis expositus. Cellulae macroconidiogenae in parietibus lateralibus et basalibus loculorum formatae, holoblasticae, hyalinae, leves, omnes conidium unum acrogenum formantes. Macroconidia fusiformia, laxe helicicurvata, extremis attenuatis, levia, hyalina, 80-140 x (5-) 5.5-6.5 (-8), $\bar{x}$ =112 x 6.3 µm, 1 (-3)-septata. Cellulae microconidiogenae in pariete superno et canale ostioli exorientes. Microconidia plus minusve cylindrica, irregulariter flexa vel tumida, levia, hyalina, aseptata, ca 5-14 x 2.5-3.5 µm. Loculi spermatigeni in eodem conidiomate ac loculi conidiogeni vel in conidiomate discreto. Cellulae spermatigenae elongatae-conicae, hyalinae, leves, discretae vel integratae spermatophoro unicellulari, phialidicae, spermata ad apices formata, 8-12 x 2.5 µm. Spermata bacillaria, hyalina, levia, 3.5-6.5 x 1.5-2 µm.

HOLOTYPE: U.S.A. ARIZONA: Cochise County, North side of Interstate Highway 10, Mile 317.2, in *foliis mortuis Dasytirionis* sp., 13 April 1992, Annette Ramaley 9216, BPI 802716. **Paratype:** MEXICO. intercepted at the Brownsville, Texas, plant quarantine station, 020413, in leaves of *Dasytirion wheeleri*, 16 March 1989, N. Guerrero, det. Mary Palm, BPI 802715.

Conidiomata (Fig. 4, E) amphigenous, subepidermal, dark brown to black, immersed, linear, mostly 250-1150 µm long, 210-550 µm wide, up to 400 µm tall, the upper surface flat, multilocular. Wall cup-shaped, attached to the host epidermis, composed of several layers of dark brown to black, thick-walled cells, lighter colored toward the interior. The top layer of the conidiomata composed of columns of golden, elongate cells. Locules with a single ostiole, the ostiolar channel surrounded by black-walled cells, exposed by breaking away of the host epidermis. Conidiophores absent. Macroconidiogenous cells (Fig. 4, B) formed on lateral and basal walls of the locules holoblastic, hyaline, smooth, each forming a single, acrogenous, conidium. Macroconidia (Fig. 4, A) fusiform, loosely helically curved, tapering toward the ends, 1 (-3)-septate, smooth, hyaline, 80-140 x (5-) 5.5-6.5 (-8), $\bar{x}$ =112 x 6.3 µm. Microconidiogenous cells formed on the upper wall of a locule and in the ostiolar channel. Microconidia (Fig. 4, C) more or less cylindric, irregularly swelled or bent, smooth, hyaline, aseptate, about 5-14 x 2.5-3.5 µm. Spermatial locules in the same conidiomata

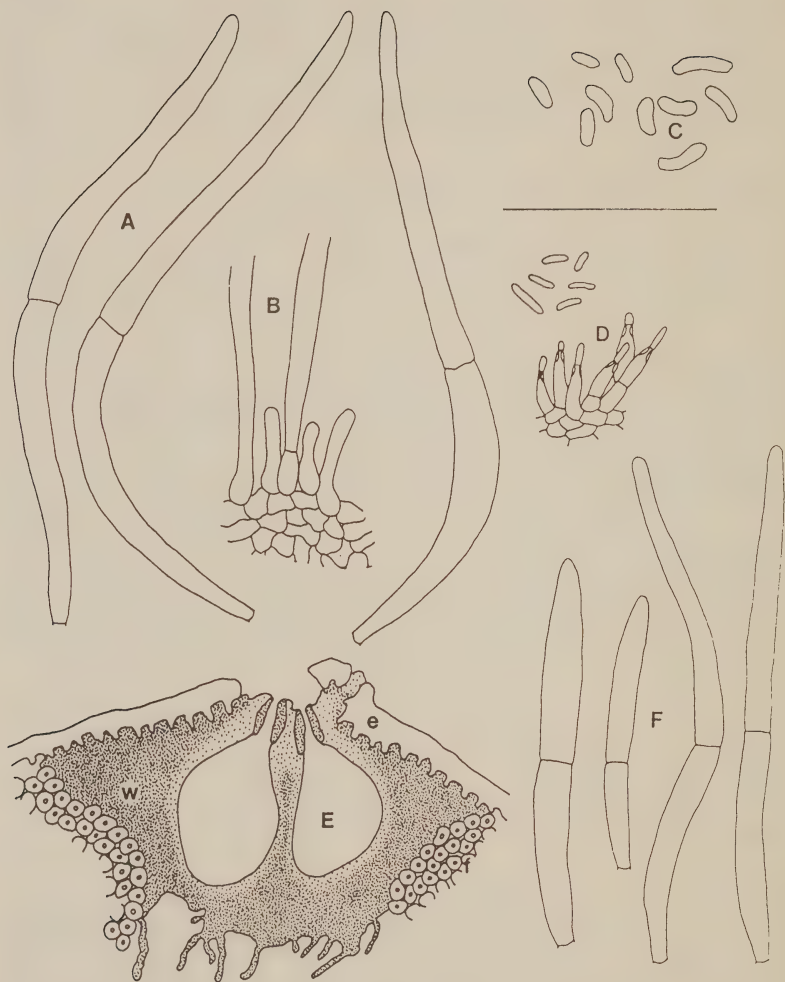


Fig. 4. *Piptarthron dasyllirionis*. A. Macroconidia from nature. B. Conidiogenesis. C. Microconidia. D. Spermatogenesis and spermatia. E. Conidioma. e=host epidermis, f=transection of leaf fibers, w=wall. F. Macroconidia from culture. Standard line: A-D, F=40 μ m; E=240 μ m.

as conidial locules or in a separate conidioma. Spermatogenous cells (Fig. 4, D) elongate-conical, hyaline, smooth, discrete or integrated on a 1-celled (usually) spermatophore, phialidic, forming spermatia at the tip, 8-12 x 2.5 μ m. Spermatia (Fig. 4, D) bacillar, hyaline, smooth, 3.5-6.5 x 1.5-2 μ m.

Substrate: Dead leaves of *Dasyllirion* sp.

Conidia from culture were somewhat shorter and narrower than from the host in nature (Fig. 4, F). However, their long, slender form is so unusual for septate members of the genus they cannot be confused with any other taxon yet encountered. A small collection of a teleomorph, confirmed by culture to be part of the holomorph including *Piptarthron daylirionis*, has aseptate ascospores, $28\text{--}40.8 \times 10.4\text{--}13.6 \mu\text{m}$. Aseptate ascospores remains a consistent character for teleomorphs of *Piptarthron* species having either septate or aseptate conidia.

The width of the linear conidiomata of this multilocular species is determined by the anatomy of the leaves of the host, *Dasyllirion*. Conidiomata are located between the subepidermal fiber bundles running the length of the leaves. Part of the dark conidiomatal wall extends over the top of the fiber bundle on each side of a conidioma forming a rim on the cup-shaped wall, and the locules and bounding wall occupy the space between the fiber bundles. More fiber bundles may be found on the abaxial than adaxial side of a leaf, consequently conidiomata on the abaxial side of a leaf may be narrower than those on the adaxial side. The width of a conidioma is occupied by one, two, or occasionally, three locules.

Planistromella torsifoliorum A. W. Ramaley, *sp. nov.*, Fig. 5, A-C.

Ascomata amphigena, immersa, subepidermalia, hemisphaerica, glabra, atra, 200\text{--}380 \times 175\text{--}270 \mu\text{m}, 1\text{--}4\text{ locularia; paries usque ad } 40 \mu\text{m} \text{ crassus, cupulatus, ex 4\text{--}6 stratis cellularum atrotunicatarum compositus, summus contra epidermidem hospitis adpressus. Stroma summum ex cellulis plus minusve columnaribus compositum, tunicae vetae cellularum fuscentes. Loculi ascogeni in eodem stromate ac loculi conidiogeni vel in stromate discreto exorientes. Loculi ovoidei vel globosi, unistrati, per columnas ex cellulis brunneis subelongatis compositis separati. Asci bitunicati, clavati, in loculo congesti, quadri- vel octospori, } 100\text{--}140 \times 28\text{--}32 \mu\text{m}. Ascosporae hyalinae, obovoideae vel ellipsoideae aspectu uno, apices obtuse rotundati vel subacuti, curvatae extremis obtuse rotundatis ubi 90 gradibus versae, uniseptatae, septum circa medium vel hemispora infera aliquantum longior quam hemispora supera, } 32\text{--}40 \times 12.6\text{--}16 \mu\text{m}. Textura interthecii sparsa, cellulae ellipsoideae vel prope globosae.

HOLOTYPE: U.S.A. TEXAS: Kimble County, intersection of Interstate Hwy. 10 and U. S. Hwy. 290, roadside, in foliis mortuis *Yuccae rupicola* Scheele, 21 October 1993, Annette Ramaley 9328, BPI 802719.

Ascomata (Fig. 5, A) amphigenous, immersed, subepidermal, hemispheric, glabrous, black, $200\text{--}380 \times 175\text{--}270 \mu\text{m}$, 1-4 loculate; wall up to $40 \mu\text{m}$ thick, cup shaped, composed of 4-6 layers of dark-walled cells, the upper part appressed against the host epidermis. The top of a stroma composed of more or less columnar cells, the old walls darkening. Ascogenous locules (Fig. 5, A) developing in the same stroma as a conidiogenous locule or in separate

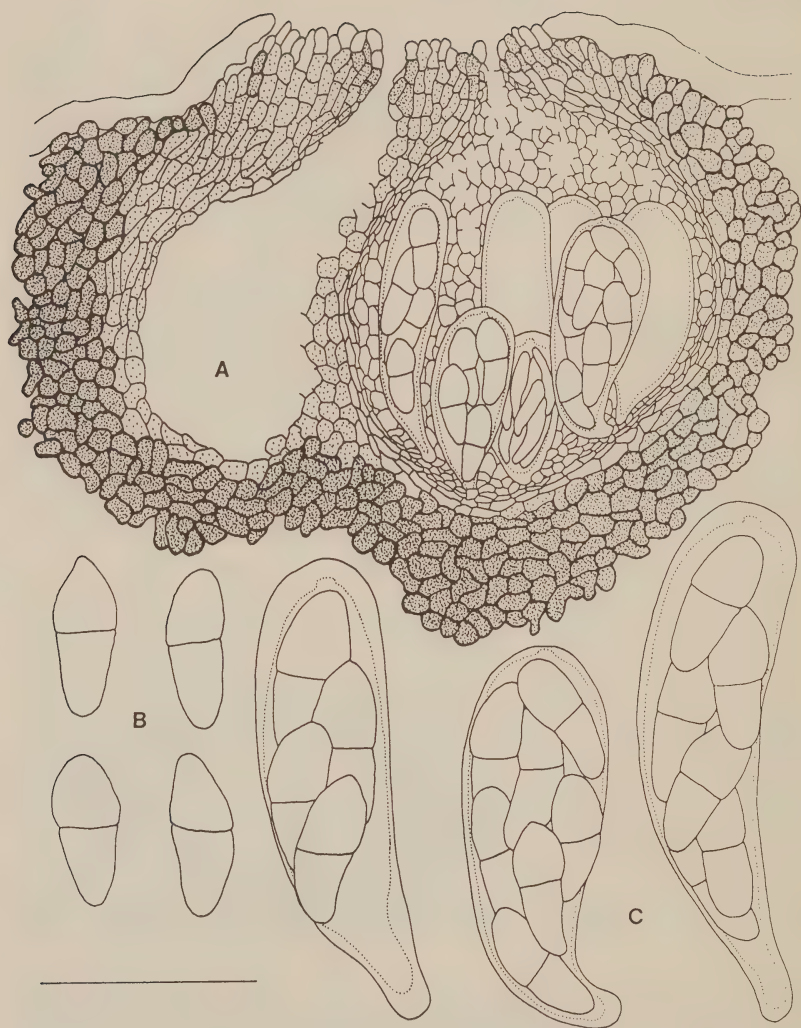


Fig. 5. *Planistromella torsifoliorum*. A. Ascoma in stroma. B. Ascospores. C. Asci. Standard line: A=100 μm ; B, C=50 μm .

stromata. Locules ovoid to globose, in a single layer, separated by columns of brown, somewhat elongated cells. Asci (Fig. 5, C) bitunicate, clavate, crowded in the locule, 4- or 8-spored, 100-140 $\times$ 28-32 μm . Ascospores (Fig. 5, B) hyaline, obovoid or ellipsoid in one view with the apex bluntly rounded or

somewhat pointed, curved with bluntly rounded ends when rotated 90 degrees, 1-septate, the septum approximately median or the bottom hemispore somewhat longer than the top, 32-40 x 12.6-16 μm . Interthelial cells sparse, the cells ellipsoid to nearly globose.

Substrate: Dead leaves of *Yucca rupicola* Scheele.

Anamorph: *Kellermania uniseptata* (Morgan-Jones, Nag Raj, and Kendrick)
Nag Raj

Alpakesa uniseptata Morgan-Jones, Nag Raj, and Kendrick

This species has been adequately described and illustrated (2). The collection that included the teleomorph differed from this description only in having larger conidiomata, up to 380 μm vs 140-280 μm diam, and larger conidia, up to 55 x 17.6 μm vs 30-43 x 10-12 μm . Much of the difference in conidial size might be accounted for by measurement of live vs long-dead conidia.

Stromata destined to form ascomata as well as conidia have a smaller conidial locule than those forming only conidia. After conidium formation, the remainder of such an ascogenous stroma consists of bulbous cells which form one or more archicarps toward the base, near the dark stromatal wall. Spermatia adhere to a narrow trichogyne which extends from each archicarp beyond the top of the stroma. The asci are basal and crowded in the locule. Asci and ascospores closely resemble those of *Planistromella uniseptata* A. W. Ramaley (5), the teleomorph of *Kellermania yuccigena*. This feature supports placement of *Alpakesa* in *Kellermania* (2) despite the difference in number of apical appendages.

KEY TO THE SPECIES OF KELLERMANIA AND PIPTARTHRON

1. Conidia lacking apical appendage.....(*Piptarthron*)....2
1. Conidia with one or more apical appendages.....*Kellermania*)....6
 2. Conidia lacking septa.....3
 2. Conidia with one or more septa.....4
3. Conidiomata with 2-4 locules, conidia 3-5 μm wide.....*P. yuccae*
3. Conidiomata with 4-30+ locules, conidia 5.5-7 μm wide.....*P. pluriloculare*
3. Conidiomata with 1-6 locules, conidia 12.8-14.4 μm wide....*P. crassissporum*
 4. Conidia scolecospores, 1(-3)-septate, apex acute.....*P. dasyilirionis*
 4. Conidia not scolecospores, mostly 2-5-septate.....5
5. Conidiomata unilocular, conidial apex very bluntly rounded...*P. uniloculare*
5. Conidiomata 1-6-locular, conidial apex somewhat acute.....*P. macrosporum*
 6. Conidia with a single apical appendage.....7
 6. Conidia with more than one apical appendage.....10
7. Length of apical appendage 12-32 μm 8
7. Length of apical appendage 5 μm or less.....9
 8. Conidia 1-septate.....*K. yuccigena*

- 8. Conidia 2-septate.....*K. anomala*
- 9. Conidia 1-septate.....*K. nolinifoliorum*
- 9. Conidia 2-septate.....*K. yuccifoliorum*
- 10. Conidia lacking septa.....*K. yuccifolia*
- 10. Conidia 1-septate.....*K. uniseptata*
- 10. Conidia 3-septate.....*K. nolinae*

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A NEW SPECIES OF *BOTRYODERMA* AND OTHER HYPHOMYCETES ISOLATED FROM ROOTS OF FUMIGATED AND NONFUMIGATED DOUGLAS-FIR STUMPS IN OREGON

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Among other hyphomycetes, *Botryoderma nigrum* Lopez sp. nov., was isolated from roots of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) stumps treated to test effects of fumigation on the root pathogen *Phellinus weirii* (Murr.) Gilb. *Trichoderma* spp. and their frequencies in roots of fumigated and nonfumigated stumps were reported earlier (Nelson et al. 1987).

METHODS

Roots of *Phellinus weirii*-colonized Douglas-fir stumps, fumigated with chloropicrin 20-mo before or left as untreated controls, were excavated and dissected at 30-cm intervals. When decay typical of that caused by *P. weirii* was encountered, a 5-cm-thick disk was removed and later sampled for resident fungi (Thies and Nelson 1987). Hyphomycetes originally isolated from 17 fumigated stumps and from six untreated stumps were grown in culture at room temperature on DIFCO potato dextrose agar (PDA), oatmeal agar (OMA), malt extract agar (MEA), and corn meal agar (CMA), and identified by the senior author. Identifications were based on keys and descriptions of Carmichael (1962), Crane and Schoknecht (1973), Ellis (1971, 1976), Gams and Holubová-Jechová (1976), De Hoog (1974, 1977, 1979), Kendrick (1962), Kendrick and Watling (1979), Nag Raj and Kendrick (1975), Raper and Thom (1968), Samson (1974) and Sigler and Carmichael (1976). Details of conidial ontogeny were observed and photographed with differential interference contrast microscopy (DIC) and fluorescence techniques with calcofluor reagent (Romero and Minter 1988).

RESULTS AND DISCUSSION

Botryoderma nigrum Lopez sp. nov.

Coloniae 3-4 cm in triginta diebus crescentes in PDA, CMA et OMA autem non in MEA. Mycelia immersa vel adpressa, incoloria, cremencia vel avellanentia, in mense densa vel mucosa, interdum crustacea, in pagina fusca vel atra, interdum aureomarginata vel umbra rubra. Centrum

coloniae elevatum, hirsutum caespitibus mycelialibus contractis, juventute avellaneum, gradatim atranti, ad marginem adpressum vel depressum. Hyphae submersae arcte contiguae, ramosae, laeves, septatae, 2-2.5 μm in diam, juventute hyalinae, maturitate brunnescentes, fuscentes vel denigricantes. Caespites myceliales cellulis sessilibus, conidiogenis, pleurogenis vel interdum terminalibus. Cellulae conidiogenae polyblasticae, juventute globosae, maturitate pyriformes, inflatae vel obpyriformes, 5-7 x 3-4 μm , parietibus laevibus, cicatricibus abscissis. Conidia unicellularia, pyriformia, basi obtusi, 3-6.5 x 2.5-3.5 μm , plerumque collo basali, juventute incoloria, maturitate atrantia, mucosa, parietibus laevibus, oriens acropete in ordinatione gemmationis torulosae, fasciculi densi in guttulis nigribus producentia.

Holotypus:BAFC 33530, colonia exsiccata in cultura, near Apiary, Oregon U.S.A. (N 45° 57' 20''; W 123° 05' 00''), legit Harlan Fay, October 1983, conservata est. Exsiccata deposited at the Herbarium of Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, BAFC. Strain isolated conserved in the Culture Collection in the same institution BAFC cult. 1156.

Colonies grew slowly reaching diameters of 3-4 cm in 30 days at room temperature on PDA, CMA and OMA, but not on MEA. Mycelia immersed to appressed, colorless, becoming cream-colored to avellaneous. After a month colonies appearing dense to mucose, sometimes crusty, dark brown to black on the surface with yellow borders and reddish shadows in some strains, elevated in the center, appressed to sunken at the borders, hirsute toward the center with emerging mycelial tufts, tapering toward the apex under the lens, avellaneous at first and gradually darkening. Submerged hyphae densely packed, branched, smooth, septate, 2-2.5 μm in diameter, at first hyaline, becoming brown, dark brown and almost black with age. Mycelial tufts bearing sessile conidiogenous cells on their surfaces in an acropleurogenous pattern or sometimes terminal on a subtending hypha (fig. 1d and 1e). Conidiogenous cells polyblastic, globose when young, later pyriform and inflated to obpyriform, 5-7 x 3-4 μm , thin walled, with one to several abscission scars (fig. 2c, 2d). Conidia one-celled, pyriform with a blunt base, 3-6.5 x 2.5-3.5 μm , usually with a collarette-like structure around the abscission scar, initially colorless, darkening to black with age and becoming thick-walled, arising in acropetal succession in a yeast-like budding pattern, producing dense clusters on the surface of the aerial tufts and prostrate mycelia. Conidia slimy, resulting in a dark colony with black droplets full of conidia easily detached when mature.

This species differs from others in Botryoderma by its smoky-black to black color of the colony, resembling some species of Exophiala (De Hoog 1977). Nevertheless, the conidial ontogeny and arrangement are characteristic of Botryoderma. The presence of fertile conical tufts instead of granular fertile clusters, the absence of sterile conidiogenous apices radiating from the clusters, and the conidial form, size, and walls separate B. nigrum from B. rostratum Papend. & Upadh. and B. lateritium Papend. & Upadh. The slower growth, absence of conidiophores, and size and wall thickness of spores separate B. nigrum from B. gigaspora Kapoor & Lal.

The genus Botryoderma was created by Papendorf and Upadhyay (1969) with two species, B. lateritium and B. rostratum, isolated from soils in South Africa and Brazil. A third species, B. gigaspora was described from India, isolated from dung of Bandicota indica (Kapoor and Lal 1982).

In all, 202 isolates from 23 stumps were identified. These comprised 28 species of hyphomycetes isolated from all stumps; 21 from fumigated and 17 from nonfumigated stumps. Ten species occurred in both fumigated and nonfumigated stumps (Table 1). Exophiala sp. and Sporothrix inflata were the most common fungi, occurring in most stumps whether fumigated or not. Botryoderma nigrum was isolated 21 times from roots of two control stumps, but was not found in roots of fumigated stumps.

Table 1. Hyphomycetes¹ isolated from decaying roots of chloropicrin-fumigated and nonfumigated Douglas-fir stumps infected by Phellinus weirii

Hyphomycetes Isolated	Treatment ²		
	Sealed	Fumigated	Unsealed
	F	F	U
<u>Acrogenospora</u> anamorph of <u>Farlowiella australis</u> Dennis	+	-	-
<u>Aspergillus</u> sp.	-	-	+
<u>Botryoderma nigrum</u> Lopez sp. nov.	-	-	+
<u>Chalara</u> anamorph of <u>Ceratocystis autographa</u> Bakshi	-	-	+
<u>Chloridium virescens</u> (Pers. ex Pers.) W. Gams & Hol.-Jech.	+	+	+
<u>Chrysosporium</u> sp.	+	-	-
<u>Cladosporium cladosporioides</u> (Fresen.) De Vries	-	-	+
<u>Exophiala</u> sp.	+	+	+
<u>Graphium</u> sp.	+	-	-
<u>Leptodontium elatius</u> (Mangenot) De Hoog	+	-	-
<u>Leptographium abietinum</u> (Peck) Wingfield	+	+	+
<u>Leptographium</u> sp.	+	+	-
<u>Moniliella</u> sp.	-	-	+
<u>Oidiodendron chlamydosporium</u> Morral	+	-	-
<u>Paecilomyces variotii</u> Bainier	+	-	-
<u>Penicillium citrinum</u> Thom	+	+	-
<u>Penicillium chrysogenum</u> Thom	-	+	-
<u>Penicillium hirsutum</u> Dierckx	+	+	+
<u>Penicillium purpureascens</u> (Sopp) Biourge	+	-	-
<u>Penicillium thomii</u> Maire	+	-	+
<u>Penicillium</u> sp.	+	-	-
<u>Rhinocladiella atrovirens</u> Nannf. in Melin & Nannf.	+	-	-
<u>Scytalidium aurantiacum</u> Klingstrom and Beyer	-	-	+
<u>Scytalidium lignicola</u> Pesante	+	-	-
<u>Spiniger meinelkellum</u> (A. Olson) Stalpers	+	+	-
<u>Sporothrix inflata</u> De Hoog	+	+	+
<u>Sporothrix</u> sp.	+	-	+
<u>Verticillium</u> sp.	+	-	-

1. (+) indicates one or more isolations; (-) indicates no isolations.

2. Stumps were fumigated (F) with chloropicrin or left untreated (U). Stump tops were sealed with a coating of roofing compound or left unsealed.

Most of the fungi in table 1 can be commonly found on wood or other organic matter, or are common inhabitants of soil. Spiniger meineckellum is the anamorph of Heterobasidion annosum (Fr.:Fr.) Bref., a root-rotting basidiomycete, not uncommon on Douglas-fir roots, causing stain and decay sometimes confused with that caused by P. weirii. Other fungi identified have teleomorphs in genera commonly associated with wood (i.e. Graphium and Sporothrix/Ophiostoma [Seifert and Okada 1993] or Chalara/Ceratocystis [Rayner and Hudson 1977]). Fungi listed in the table that have been previously reported on roots of Douglas-fir are Spiniger meineckellum and Scytalidium lignicola (Farr et al. 1989). Exophiala sp., Cladosporium cladosporioides, and P. variotii have been mentioned as soft rotting fungi in softwood poles (Wang and Zabel 1990).

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The authors thank Dr. H. P. Upadhyay for confirmation of the newly described species, Botryoderma nigrum and reviewing the manuscript; Dr. James Trappe for the Latin translation and reviewing the manuscript; and Dr. Jeff Stone for reviewing the manuscript.

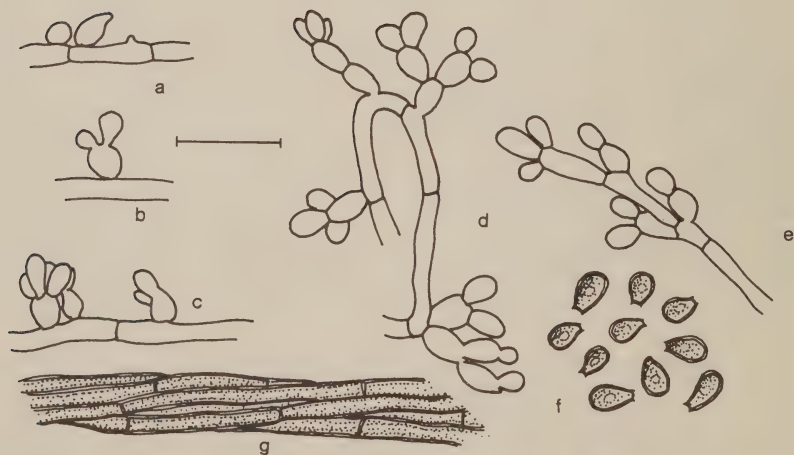


Figure 1. Botryoderma nigrum. (a) conidiogenous cell; (b-e) different states during conidiogenesis, (d) pleurogenous pattern, (e) terminal pattern; (f) mature conidia; (g) mycelial tuft. Bar = 10 μ m.

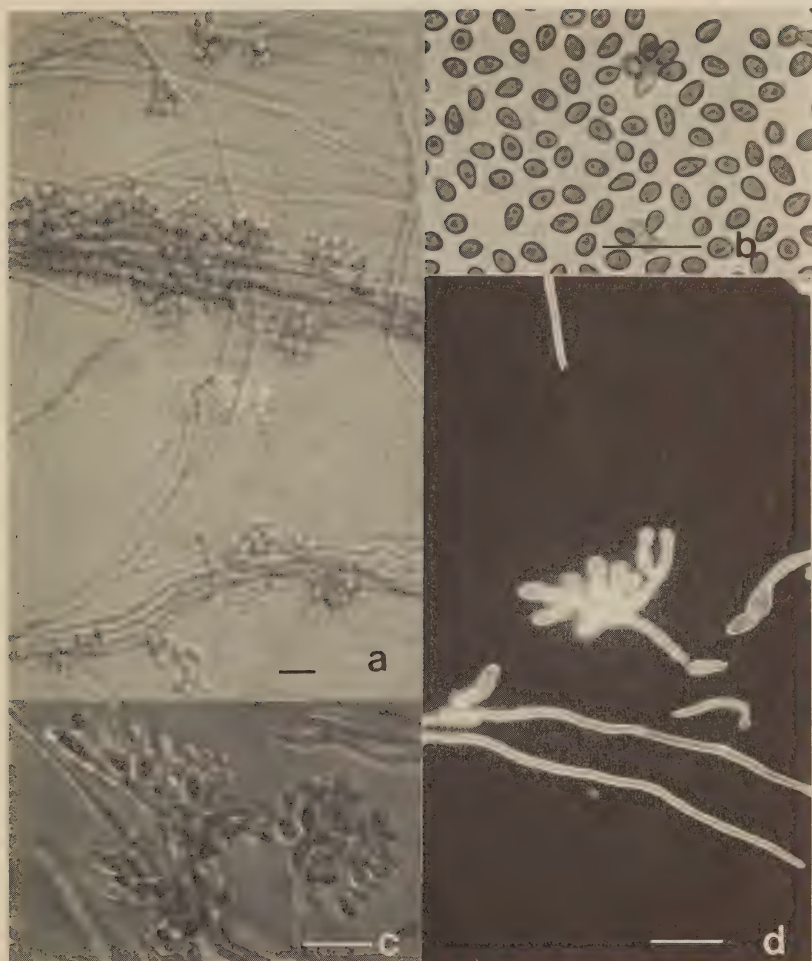


Figure 2. Botryoderma nigrum. (a) general aspect of mycelial tufts; (b) mature conidia; (c) clusters of conidiogenous cells and conidia viewed with DIC; (d) viewed with fluorescence. Bars = 10 μ m.

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TWO NEW INTERESTING ASCOMYCETES FROM

IRIAN JAYA AND PAPUA NEW GUINEA

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Abstract

Clavatisporella musicola gen. et sp. nov. and *Plagiostoma perseae* sp. nov. are described from Irian Jaya and Papua New Guinea respectively. *Clavatisporella musae* developed on senescent banana leaves in Jayapura, Irian Jaya, while *Plagiostoma perseae* formed leaf spots on avocado in Vanimo, Papua New Guinea. Both fungi are illustrated with interference contrast micrographs and *P. perseae* is compared with possible related taxa.

Introduction

Between May 1989 - June 1992 I had the opportunity to carry out detailed surveys of the fungi and other microorganisms associated with diseased plants in the Cape York Peninsula, Torres Strait Islands, Western Papua New Guinea and Irian Jaya. The surveys resulted in the discovery of several new taxa (Hyde & Philemon, 1991) or new descriptions of formerly inadequately described pathogens (Johnson & Hyde, 1992) as well as host/pathogen lists (Hyde & Alcorn, 1993; Hyde & Philemon, 1994).

An unusual diaphothaceous taxon having clavate ascospores provided with basal septa and apical mucilaginous appendages was collected on senescent banana leaves in Jayapura, Irian Jaya. As it cannot be accommodated in any previously described genus, *Clavatisporella* gen. nov. is introduced to accommodate it. A second species characteristic of *Plagiostoma* Fuckel was also associated with leaf spot on avocado. Surveys of the literature indicate that this species is undescribed and therefore *Plagiostoma perseae* sp. nov. is introduced.

TAXONOMY

Clavatisporella K.D. Hyde, gen. nov.

Ascomata immersa, globosa vel subglobosa, pallide brunnea, ostiolata. Asci 8-spori, cylindraci vel clavati, pedunculati, unitunicati, truncati, apparato subapicali praediti. Ascosporae 2-3 seriatae, fusiformes vel clavatae, hyalinae, 1-2-septatae, appendiculatae. *Typus generis*: *Clavatisporella musicola* K.D. Hyde, sp. nov.

Etym. From the Latin *clavatus* meaning club-shaped, and spora.

Ascomata immersed in host tissue, visible as slightly darkened areas on the upper leaf surface; in vertical section globose or subglobose, light brown, with an eccentric, aperiphysate non-protuding ostiole. Peridium comprising light-brown, thin-walled, elongate cells. Paraphyses comprising ovoid cells, becoming narrow and filamentous distally, short and numerous. Asci 8-spored, broad cylindrical or clavate, pedunculate, unitunicate, apically somewhat truncate, with a subapical refractive ring. Ascospores 2-3 seriate, irregularly fusiform to clavate, hyaline, base swollen with one or two septa, narrowing to the apex where septa are lacking and provided with a mucilaginous pad-like appendage at the end. *Type species*: *Clavatisporella musicola* K.D. Hyde sp. nov.

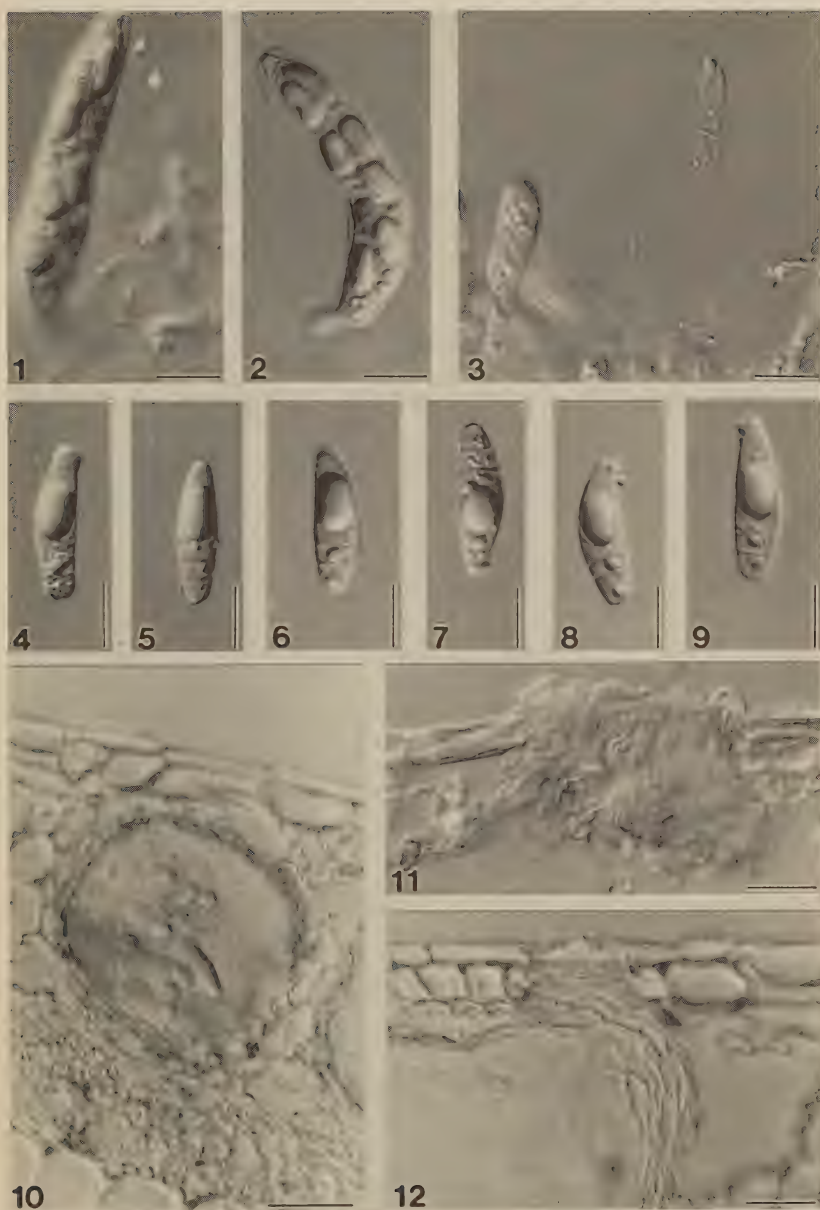
Clavatisporella musicola K.D. Hyde, sp. nov.

Figs 1-12.

Ascomata immersa, in sectione ad per 140 μm diam, 120 μm alta, globosa vel subglobosa, pallide brunnea, ostiolata. Asci 93-140 x 12-15 μm , 8-spori, cylindraci vel clavati, pedunculati, unitunicati, truncati, apparato subapicali 4 μm diam, 2 μm alti praediti. Ascosporae 21-30 x 6-9 μm , 2-3 seriatae, fusiformes vel clavatae, hyalinae, 1-2-septate, appendiculatae.

Etym.: In reference to the host genus.

Figures 1-12. Interference contrast micrographs of *Clavatisporella musicola*. 1,2. Asci. Note the refractive subapical ring. 3. Paraphyses. 4-9. Ascospores with basal septa and apical mucilaginous pad-like appendage. 10. Section of ascoma. 11. Neck. 12. Peridium. Bar lines = 10 μm (except 10 = 50 μm).



Ascomata immersed in host tissue, visible as slightly darkened areas on the upper leaf surface; in vertical section up to 140 μm diam, 120 μm high, globose or subglobose, light-brown, with an eccentric, aperiphysate non protuding ostiole (Figs 10, 11). Peridium up to 10 μm wide, comprising 3-4 layers of light-brown, thin-walled, elongate cells (Fig. 12). Paraphyses up to 11 μm wide at the base, comprising ovoid cells, becoming narrow and filamentous distally, short and numerous (Fig. 3). Asci 93-140 x 12-15 μm , 8-spored, broad cylindrical or clavate, pedunculate, unitunicate, apically somewhat truncate, with a subapical refractive ring, 4 μm diam, 2 μm high (Figs 1,2). Ascospores 21-30 x 6-9 μm , 2-3 seriate, irregularly fusiform to clavate, hyaline, base swollen with one or two septa, narrowing to the apex where septa are lacking; large apical cell containing a large lipid body and provided with a mucilaginous pad-like appendage at the end (Figs 4-9).

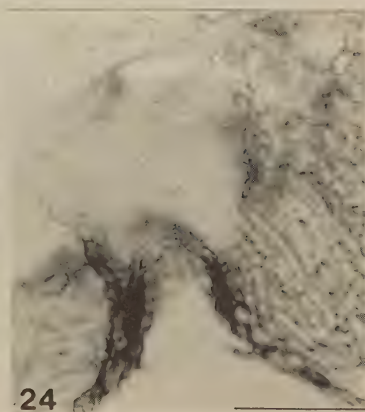
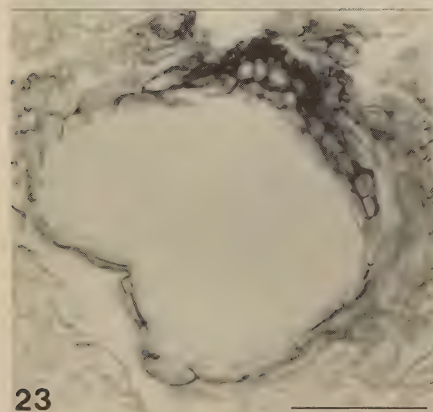
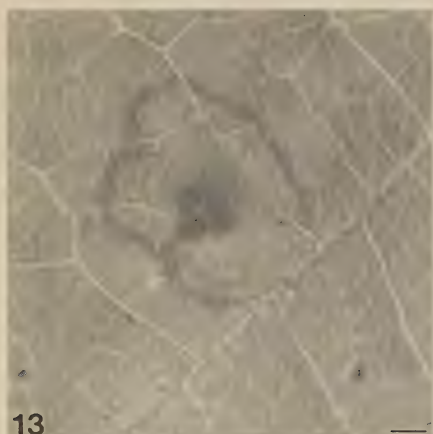
Habit: Saprobic on senescent *Musa* leaf.

Known distribution: Irian Jaya (Indonesia).

Holotype: INDONESIA: Irian Jaya, Jayapura, on dead banana leaf, May 1992, K.D. Hyde & N. Raga, KDH 1219, BRIP 22403.

Clavatisporella musicola is characterised by fusiform to clavate, hyaline ascospores with irregular septation at the base and narrowing at the apex where a mucilaginous pad is provided. Asci are broad cylindrical to clavate with a refractive subapical ring, while ascomata are immersed. This taxon with the combination of these characteristics cannot be accommodated adequately in any existing genus and therefore *Clavatisporella* is introduced. The placement of *Clavatisporella* is questionable, but broad cylindrical asci with a subapical refractive ring are characteristic of the Diaporthales (Barr, 1978; Monod, 1983). The papillate ascomata, oblong, stipitate asci, wide paraphyses and ascospore septation indicate a relationship with *Buergenerula* Syd. (Barr, personal communication), a genus presently placed in the Hyponectriaceae. However, no surface mycelium bearing hyphopodia were observed.

Figures 13-24. Interference contrast micrographs of *Plagiostoma perseae*. 13. Leaf spot. 14. Squash of ascoma. 15, 16. Asci. Note the refractive subapical ring and canal leading to the tip. 17-21. Ascospores with polar appendages that unravel in water. 22. Tip of ascus with subapical ring and canal to tip. 23. Section of ascoma. 24. Section of ostiole. Bars: 13 = 1 mm, 14, 23 = 50 μm , 15-22, 24 = 10 μm .



Macula ad per 7 mm diam, brunnea. Ascomata 90-145 μm diam, immersa, subglobosa, brunnea, ostiolata. Asci 82-98 x 17-22.5 μm , 8-spori, cylindraci vel clavati, unitunicati, truncati, apparato subapicali, 4 μm diam, 2 μm alti, praediti. Ascosporae 20-25 x 8.5-10 μm , 2-3-seriatae, hyalinae, bicellulae, appendiculatae.

Etym.: In reference to the host genus.

Leaf spots up to 7 mm diam, irregular, obvious on both the upper and lower leaf surfaces, brown, necrotic, with blackened centres (Fig. 13). Ascomata scattered, occurring mostly on the lower surface of the leaf, erumpent through host epidermis, black where exposed and papillate; in section 90-145 μm diam, immersed, subglobose, brown, with an eccentric ostiole (Figs 14, 23, 24). Peridium up to 30 μm (mostly 10-15 μm) wide, comprising 2-5 layers of large brown-walled, somewhat flattened, angular cells (Fig. 23). Paraphyses up to 10 μm wide at the base, sparse, cylindrical and tapering distally. Asci 82-98 x 17-22.5 μm , 8-spored, broad cylindrical to clavate, not or with a stump-like peduncle, thin-walled, unitunicate, apically truncate, with a subapical refractive ring, 4 μm diam, 2 μm , high and with a faint canal leading to the apex (Figs 15, 16, 22). Ascospores 20-25 x 8.5-10 μm , 2-3 seriate, some slightly curved, hyaline, 1-septate slightly constricted at the septum, basal cell smaller (8-10 μm), with somewhat acute ends and with polar mucilaginous pads (Figs 17-21).

Holotype: Papua New Guinea, Green River, on living leaves of *Persea americana* Miller, May 1992, K.D. Hyde 1361, BRIP 20383.

In *Plagiostoma* stromatic tissues are not formed, while ascomata are immersed with eccentric or lateral necks. Asci are oblong ellipsoidal, while ascospores are hyaline with a median, suprmedian or submedium septum and often appendaged (Barr, 1978; Monod, 1983). *P. perseae* is therefore characteristic and can readily be included in this genus. Fröhlich & Hyde (1994) have recently described and illustrated *Plagiostoma euphorbiae* (Fuckel) Fuckel and a related genus *Maculatipalma* Fröhl. & K.D. Hyde on palms. This new genus differed from *Plagiostoma* in having broad, cylindrical, apically truncate asci with a refractive subapical discoid ring and ascospores with a large basal cell.

Several fungi are known to cause leaf spots of *Persea americana* (avocado), although *Pseudocercospora* sp. is probably one of the most important

diseases in Australia (Persley, 1993). *Cephaleuros virescens* Kunze (Algae) is the only leaf-spotting pathogen of avocado recorded in Papua New Guinea (Shaw, 1984; Mutappa 1987; Hyde & Philemon, 1994). Several fungi recorded on *Persea americana* need consideration. *Coccoidella perseae* Sivanesan, *Guignardia perseae* Punith., *Othiella brenesii* Petr., *Peroneutypa perseae* Rieuf & Teasca, *Phyllachora gratissima* Rehm and *Endothia hauanensis* Bruner can be dismissed since these genera are unlikely to be confused with *Plagiostoma*. In *Mycosphaerella perseae* L.E. Miles the ascospores are very small (12-13 x 3-4 μ m) (Saccardo, 1928) while in *Physalospora perseae* Doidge they are aseptate (Doidge, 1922). It is therefore unlikely that *Plagiostoma perseae* has previously been described from *Persea americana*.

Acknowledgements

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LOPHIOSTOMA ASIANA SP. NOV. FROM THAILAND
MANGROVES

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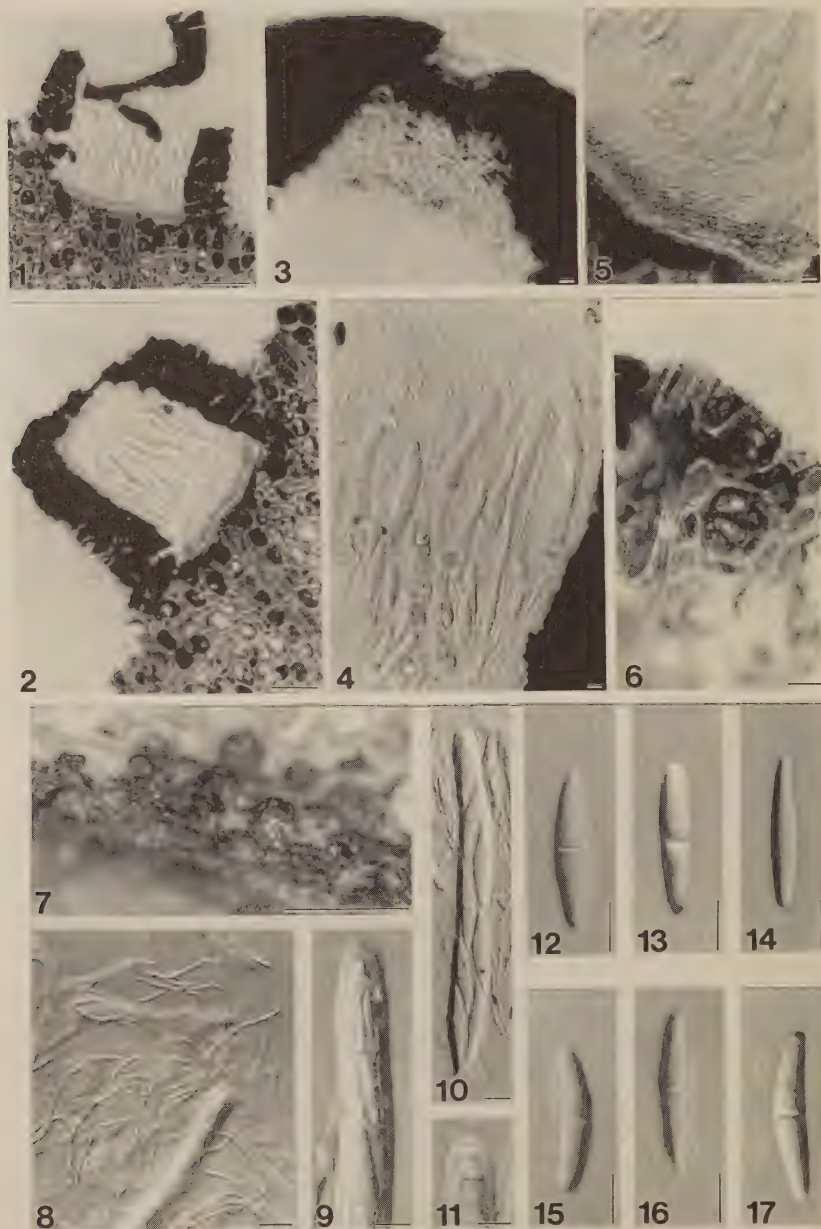
Abstract

Lophiostoma asiana sp. nov. from Thailand mangroves is described and illustrated. This species has smaller ascospores than *Lophiostoma mangrovei*, but is similar in most other respects.

Introduction

Lophiostoma mangrovei Kohlm. & Vittal was described from bark and wood of mangroves (*Avicennia officinalis* L., *Rhizophora mangle* L., *R. mucronata* Lamk.) from the Atlantic Ocean (Belize) and Indian Ocean (India) by Kohlmeyer and Vittal (1986). Collections *Lophiostoma* in Thailand revealed two distinct taxa; one with ascospores of similar size to those reported for *Lophiostoma mangrovei* (originally named as *L. mangrovis*) and a second with smaller ascospores (Hyde, Chalermpongse & Boonthavikoon, 1990). Differences are considered great enough to warrant separate species status.

In both of this these taxa the centrum is melanommataceous comprising trabeculae in a gelatinous matrix. *Lophiostoma*-like taxa with this centrum type should be referred to *Ostropella* (Sacc.) Höhn., *Platystomum* Trevisan, *Navicella* Fabre or *Thyridaria* Sacc. (Barr, 1992). A closer study of these genera (Barr,



Figs 1-17. *Lophiostoma asiana*. 1,2. Sections of ascomata. 3. Section through ostiole. 4. Arrangement of asci and trabeculae in ascoma. 5. Hymenium at base of ascomata. 6. Section of peridium with host cells. 7. Surface view of ascomata. 8. Trabeculae. 9-11. Asci. Note the apical ring in 9 and 11. 12-17. Ascospores. Scale Bars: 7 = 1mm, 1,2 = 100 μm , 3-6, 8-17 = 10 μm .

1990) indicated that none could accommodate the marine taxa adequately. The option is therefore to introduce a new genus or to place these species in a rather unsuitable preexisting genus (e.g. *Lophiosphaera* Trevisan). This problematic area is presently under investigation (Huhndorf, pers. comm.) and therefore *Lophiostoma* is currently considered the most convenient placement for this new species.

Taxonomy

Lophiostoma asiana K.D. Hyde, sp. nov. - Figs 1-17.

Ascomata ca 210-300 μm alta, 350-700 μm diam, erumpentes, carbonacea, nigra, gregaria. Asci 150-175 x 15-20 μm . Ascosporae 28-40 x 5-8 μm , fusiformes, bicellulae, hyalinae, tunica gelatinosa praeditae.

Holotypus: Thailand, Ranong mangrove, on exposed roots of *Aegiceras corniculatum*, Nov 1988, K.D. Hyde 817, BRIP 22611.

Ascomata ca 210-300 μm high, 350-700 μm diam, erumpent, developing on a thin black stromatic crust, opening with an elongated slit-like ostiolum, carbonaceous, black, gregarious (Figs 1,2,7). Peridium 75-100 μm thick at the sides, 25-37 μm at the base, encrusted with melanin particles, upper side wall black, composed of blackened fungal tissue and host cells; top composed of black fungal tissue forming a texture intricata (of irregular

rounded cells and long hyphae); basal wall of small hyaline or light brown rounded cells (Figs 1,2,5,6). Ostiolar cleft composed of hyaline brick-shaped cells (Fig. 3). Stromata composed of host cells and intracellular brown fungal hyphae. Pseudoparaphyses up to 1 μm diam, trabeculae in a gelatinous matrix (Figs 4,8). Asci 150-175 x 15-20 μm , 8-spored, cylindrical or slightly wider near the base, pedunculate, thick-walled, fissitunicate, with an ocular chamber and faint ring, arising from the base of the ascoma (Figs 9-11). Ascospores 28-40 x 5-8 μm ($x = 34.82 \times 7 \mu\text{m}$, $n = 50$), biseriate, broad fusiform with rounded ends, one-septate, hyaline, surrounded by a narrow mucilaginous sheath which is drawn out at the ends (Figs 12-17).

Known distribution: Thailand.

Known hosts: *Aegiceras*, *Sonneratia*.

Material examined: Thailand, Ranong mangrove, on exposed roots of *Aegiceras corniculatum*, Nov 1988, K.D. Hyde 817, BRIP 22611 (holotype); on exposed roots of *Sonneratia alba*, Nov 1988.

Lophiostoma asiana differs from *L. mangrovei* in having smaller ascospores (28-40 x 5-8 μm , vs. (36-) 37.6-55.2 x 6.9-11.1 μm , (50-58 x 9-10 μm in the Thailand specimen), which also differ in shape, being broad fusiform in the former as compared to fusiform in the latter. In most other aspects the fungi are similar, although the ascomata in *L. asiana* are conical to mammiform, as compared to broadly oblong in *L. mangrovei*. Collections of *L. mangrovei* on *Rhizophora apiculata* and *Sonneratia griffithii* had consistently larger ascospores than those of *L. asiana* occurring on *S. griffithii* and *Aegiceras corniculatum*. The possibility that *L. asiana* was an immature collection was also considered. However, there were several old ascomata lacking contents amongst the mature ascomata containing asci and ascospores. The latter taxon was common on

decayed roots of *Aegiceras corniculatum*.

Tab. 1 Synopsis of *Lophiostoma mangrovei* and *L. asiana*

	<i>L. mangrovei</i>	<i>L. asiana</i>
Ascomata	775-950 μm long 450-535 μm diam 260-400 μm high	350-700 μm diam 210-300 μm high
Asci	155-218 x 13.4- 19.2 μm	150-175 x 15-20 μm
Ascospores	(36-) 37.6-55.2 x 6.9-11.1 μm	28-40 x 5-8 μm

Acknowledgments

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SCANNING ELECTRON MICROSCOPY OF
CONIDIOGENESIS IN *CIRCINOTRICHUM MACULIFORME*

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Abstract

Conidial production in *Circinotrichum maculiforme*, investigated by SEM, is found to be phialidic, and similar to that described for *Cacumisporium capitulatum*, *Chloridium virescens* and *Gonytrichum* spp.

Circinotrichum was erected by Nees (1817) for a species, *C. maculiforme*, found on decaying oak leaves. Little was known about the conidial ontogeny in this genus until Pirozynski (1962) described, for the *Circinotrichum-Gyrophthrix* group, an apparently simultaneous production of conidia in a ring just below the apex of the conidiogenous cell and the vertical elongation of the apex, after producing the first crop of conidia, leaving behind a thickened annular scar. Ellis (1971), substantially agreeing, described conidiogenous cells in *Circinotrichum* as polyblastic and percurrent. Pirozynski & Patil (1970) suggested analogy between the conidiogenous cell tip of *Circinotrichum* or *Gyrophthrix* and the one of *Chloridium virescens* var. *chlamydosporum* (van Beyma) W. Gams & Hol.-Jech. [referred to as *Chloridium chlamydosporis* (van Beyma) S. Hughes], as illustrated by Mangelot (1952) or that of *Cacumisporium capitulatum* (Corda) S. Hughes, as demonstrated by Goos (1969). They suggested also analogy with *Exophiala jeanselmei* var. *heteromorpha* [referred to as *Margarinomyces heteromorphus* (Nannf.) Mangelot], that, on the contrary, is at present considered annellidic (De Hoog, 1977; Cole & Samson, 1979; Domsch *et al.*, 1980). Hammill (1972) confirmed the morphology illustrated by Mangelot (1952) making electron microscope observations of wall differentiation during conidiogenesis in *C. virescens* var. *chlamydosporum*; in this paper, Hammill showed, by TEM, that the outer layer of the conidial wall is continuous to the inner layer of the conidiogenous cell, called by him "sympodulo-phialide". Gams &

Holubová-Jechová (1976) stated that in this last species conidia are blown out sequentially from new growing points within the phialide apex, as it also occurs in *Gonytrichum*.

Sutton (1973), describing the conidiogenous cells of *C. capitulatum*, suggested that they "are distinctly annellidic, but only with 2–5 transverse hyaline to sub-hyaline annellations above the first distinctive brown one figured by Goos (1969) and Mangenot (1953). More than a single conidium sometimes appears attached to the apex of the conigenous cell, indicating that if this indeed occurs in spite of the presence of annellides, the conidiogenous loci may be multiple. This is similar to the situation seen in *Ceratocladium microsporum* Corda (Hughes, 1951) and *Circinotrichum* spp. (Pirozynski, 1962)".

Cunningham (1974) described the conidiogenesis in *Gyrothrix pediculata* Cunningham as phialidic *sensu stricto*, after studying it with time-lapse in pure culture. In this species, single conidia are produced successively, from conidiogenous cells with a tip "usually truncate to very slightly flaring to form a slight collarete", without any proliferation. Sutton (1980) agreed with him, describing conidiogenous cells of *Circinotrichum rigidum* Sutton as "enteroblastic, phialidic".

But what are the annular scars described by Pirozynski (1962), and actually visible in many species of this group? Why can we often see the apex of conidiogenous cells attached to a group of liberated spores, if conidiogenous cells are phialidic *sensu stricto*?

Methods and Materials

Specimens from dead leaves of *Populus x euroamericana* and from pure culture were fixed in 5% glutaraldehyde in 0.2 M sodium phosphate buffer (pH 7.2) and post-fixed in 1% OsO₄ in 0.2 M cacodylate buffer (pH 7.2), dehydrated in a graded acetone series, critical-point-dried, coated with gold and then observed with a Cambridge Stereoscan 200.

Specimens examined: ROHB 91, *C. maculiforme* Nees, on dead leaves of *Populus x euroamericana*, leg. M. Leone, 27.I.1988, c/o C.S.A.F., Casalotti, Rome, Italy; pure culture from ROHB 91.

Results

Scanning electron micrographs show that conidial formation in *C. maculiforme* is phialidic, without any contribution of the outermost wall layer of the conidiogenous cell to the conidial wall (Fig. 1 a); but conidiogenesis seems to be "holoblastic" by an inner layer of the conidiogenous cell wall (Fig. 1 b): successive conidia are produced laterally to the previous one, and multiple conidiogenous loci are formed (Fig. 1 c). The conidia remain grouped around the tip of the conidiogenous cell (Fig. 1 d). After detachment, conidia may remain aggregated and mucilage is involved in this conidial package (Fig. 1 e).

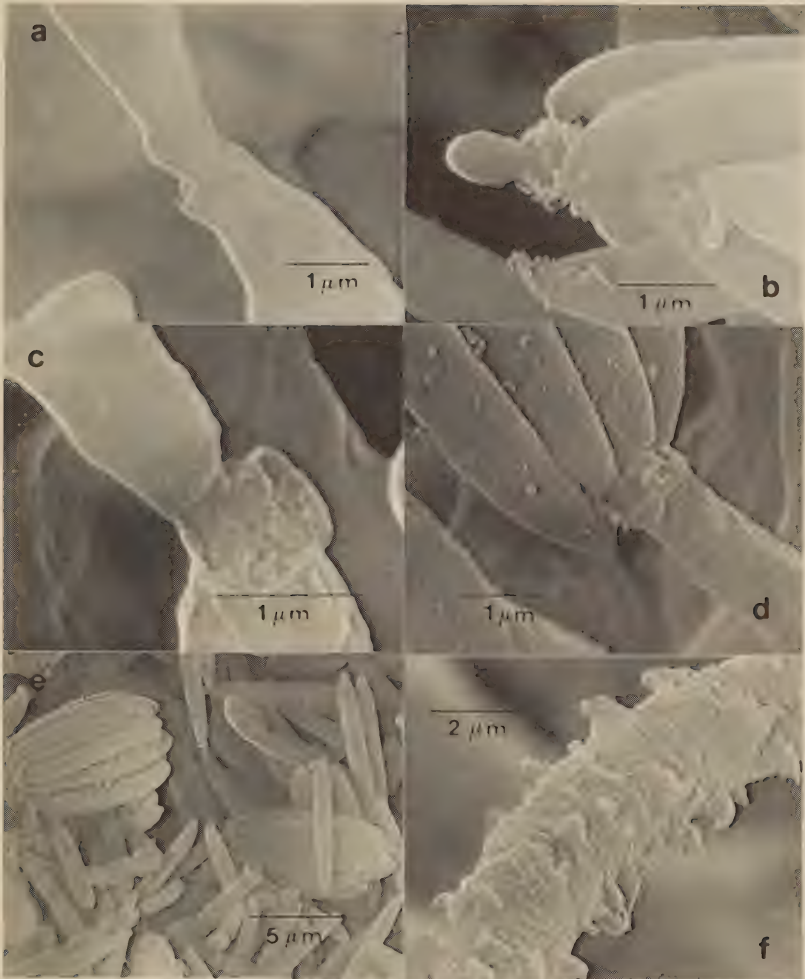


Fig. 1. - *Circinotrichum maculiforme* (SEM): a) conidia protruding from the conidiogenous cells; the outer wall layer of the conidiogenous cell is clearly not continuous with the conidial wall; b) a young conidium seems to be produced "holoblastically" by an inner layer of the conidiogenous cell wall; c) the uneven apex of a conidiogenous cell suggests multiple conidiogenous loci, next to a still attached conidium; these loci are internal to the outermost wall layer of the conidiogenous cell; d) conidia attached to the tip of the conidiogenous cell: the outer wall layer of the conidiogenous cell forms a frill below the tip; e) groups of detached conidia, partly aggregated, to left cluster showing some remnants of slime; f) roughened surface of a coiled seta.

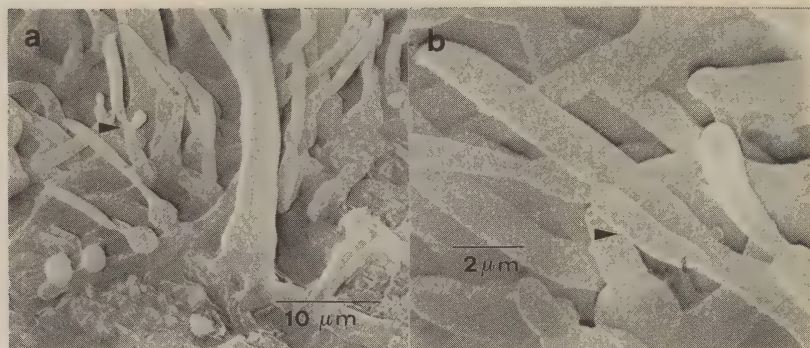


Fig. 2. - *Circinotrichum maculiforme* (SEM): a, b) conidiogenous cells showing developing (arrow-heads) and well-developed conidia, probably indicating asynchronous conidial production.

The outermost layer remains as a frill around the multiple conidiogenous loci (Fig. 1 d).

As shown in Fig. 1 f, setae are coarsely roughened in the coiled part.

The conidia produced by a single conidiogenous cell seem in different stages of development at the same time (Fig. 2 a, b).

Discussion

Conidial production in *C. maculiforme* is similar to that described by Goos (1969) for *Cacumisporium capitulatum* and by Hammill (1972) for *Chloridium virescens* var. *chlamydosporum*, but also to *Dictyochoeta setosa* (Hughes & Kendrick) Cabello & Arambarri (Hughes & Kendrick, 1968; Cole & Samson, 1979) and *Gonytrichum* (Swart, 1959), where the outer layer of the conidiogenous cell wall is not involved in conidium production. The inner layer(s) of the conidiogenous cell wall could produce the conidial wall, by a mechanism intermediate between phialidic and 'sympoduloconidiogenous', as described for *Chloridium virescens* var. *chlamydosporum* by Gams & Holubová-Jechová (1976). This kind of conidiogenous cells may be called as 'polyblastic' phialides.

The frill observed and interpreted as a remnant of the outer wall layer of the conidiogenous cell could look like a number of annular scars under the optical microscope.

In *Circinotrichum* clusters of conidia sometimes can be observed attached to the detached apex of the conidiogenous cell. This detached apex is probably just the elongated thin-walled part produced inside the conidiogenous cell.

Although conidia often appear as uniform coherent clusters, conidial production is probably asynchronous, as developing and fully developed conidia can be observed on the same conidiogenous cell (Fig. 2).

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NEW DATA ON THE GENUS *WYNNEA* IN MEXICO

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ABSTRACT

Wynnea macrotis (Berk.) Berk. is described for the first time from Mexico (State of Veracruz). It was only known from India and Tibet and doubtfully reported from Mexico. A discussion on the previously two known species from Mexico is presented, as well as a key for the three known species.

RESUMEN

Se describe *Wynnea macrotis* (Berk.) Berk. por primera vez de México (del Estado de Veracruz). Esta especie se conocía solamente de la India y del Tibet y dudosamente de México. Se discuten las dos únicas especies previamente conocidas de México y se presenta una clave de las 3 especies.

INTRODUCTION

The genus *Wynnea* Berk. & M.A. Curtis is one of the most peculiar within the Pezizales with large ascomata (up to 100 mm diam.) and auriculate, spatulate, otideoid or sparassoid form, arising from a hypogeous stipe or rhizomorph. Microscopically it can be distinguished by its non-amyloid asci, navicular ascospores in frontal view and subreniform in lateral view and ornament walls (Seaver, 1928; Rifai, 1968; Korf, 1972; Pfister 1979). According to Pfister (op. cit.) *Wynnea* includes 4 species: *W. americana* Thaxt., *W. gigantea* Berk. & M.A. Curtis, *W. macrotis* (Berk.) Berk. and *W. sparassoides* Pfister. Recently Lui *et al.* (1989) described two species from China: *W. macrosopora* Liu et Cao and *W. sinensis* Liu et Cao. Preparations for microscopic studies were made in 5% KOH, Melzer's reagent and cotton blue in lactophenol. Colors were based on Kornerup and Wanscher (1978).

WYNNEA MACROTIS IN MEXICO

Wynnea macrotis (Berk.) Berk., *J. Linn. Soc. Bot.* 9: 424. 1867.

Figs. 1-5

Apothecia 15-70 mm wide, 40-100 mm high, coriaceous and broadly auriculate. Hymenium violet brown (10F5), with external surface

dark brown (6F7) or reddish brown (8E6), gray brown (10F2) towards the top, pruinose to slightly villose. Stipe 25-70 x 5-20 mm, hypogeous with a rizomorphic prolongation, coriaceous, dark brown (6F5-7F5), smooth to irregularly striate. Asci 240-320 x 17.6-19.2 μm , laterally operculate, hyaline, apex not stained in Melzer's reagent, 8-spored, slightly attenuate below. Ascospores 22.5-29.6 (-30.4) x 10.8-13.5 μm , navicular in frontal view and subreniform in lateral view, walls striate, the majority triguttulate, uniseriate. Paraphyses (4-) 4.8-5.6 μm diam., apex clavate about 6.4 μm , branched or simple, hyaline, sparingly septate. Medullary excipulum textura intricata, hyphae 4.5-10.8 μm diam., thin walled and hyaline. Ectal excipulum with globulose to angular cells 12-17.6 x 12-40 μm , with a little appendage, orange brown or reddish brown in KOH; these cells give a pruinose macroscopic aspect to the external surface.

Habitat. Gregarious, on the ground in a mesophitic forest at 1400 m altitude.

Material studied. Mexico, State of Veracruz, Municipio San Andrés Tlalnehuayocan, road San Bruno to Plan de Cedeño, near San Bruno, June 27, 1984, **Guzmán 24397** (XAL).

Discussion. *W. macrotis* was previously only known from India and from Tibet (Pfister, 1979). However Cooke (1875-1879) and Saccardo (1889) reported this species from Mexico without a precise locality. Thaxter (1905) stated that these reports were not confirmed. The material studied conforms with Pfister (1979) and Waraitch (1976). The latter author described *W. macrotis* as *W. intermedia* Waraitch which is a synonym (Pfister 1979). *W. macrotis* is distinguished by the appendage of the terminal cells of the ectal excipulum and by the ascospore wall with a fine ornamentation.

PREVIOUSLY REPORTED SPECIES FROM MEXICO

W. gigantea Berk. & M.A. Curtis, **J. Linn. Soc. Bot.** 9: 424. 1867

Fig. 7

This species was described by Berkeley and Curtis from the region of Orizaba, Veracruz (Mexico), on a Botteri collection (Thaxter 1905), but after that was not collected (García *et al.*, 1970). However Imazeki and Hongo (1971), Otani (1980) and Teng (1939) reported it from Japan and China, and Pfister (1979) from Brazil and Peru. The species can be distinguished by the absent appendage on the superficial

cells and by its ascospores 30-33 (-35) x 13-16 μm .

Material studied: JAPAN, Kyoto, near Choji-dani, Ashue, Miyama-ehô, July 28, 1966, **Yoshimi 3266** (ENCB, XAL).

W. americana Thaxt., **Bot. Gaz.** 39: 246. 1905

Fig. 6

This species was described from the eastern U.S. by Thaxter (1905) and it is the best known in Mexico. It was reported by Valenzuela *et al.* (1981) from the Amecameca zone in the State of Mexico, in a mesophitic forest, by Chacón and Bautista (1988) from Morelos State, in an *Abies religiosa* forest and by Cifuentes *et al.* (1991) and Pompa-González and Cifuentes (1991) from Los Azufres region, State of Michoacan, in a *Pinus-Quercus* forest. The differential characteristics of *W. americana* are the ectal excipulum that has terminal cells with an appendage and ascospores, 35-38 (-40) x 12-14 (-18) μm .

Material studied: Mexico, State of Mexico, Municipio Amecameca, 1 km N of San Antonio, October 2, 1977, **Pérez-Ortiz 1074** (ENCB, XAL).

KEY TO SPECIES OF WYNNEA FROM MEXICO

1a. External cells of ectal excipulum with appendage.

Ascospores with slight striations, 22-31 (-32) μm long

..... *W. macrotis*

1b. External cells of ectal excipulum without appendage.

Ascospores with strations well defined 2

2a. Ascospores 30-33 (-35) μm long *W. gigantea*

2b. Ascospores 35-38 (40) μm long *W. americana*

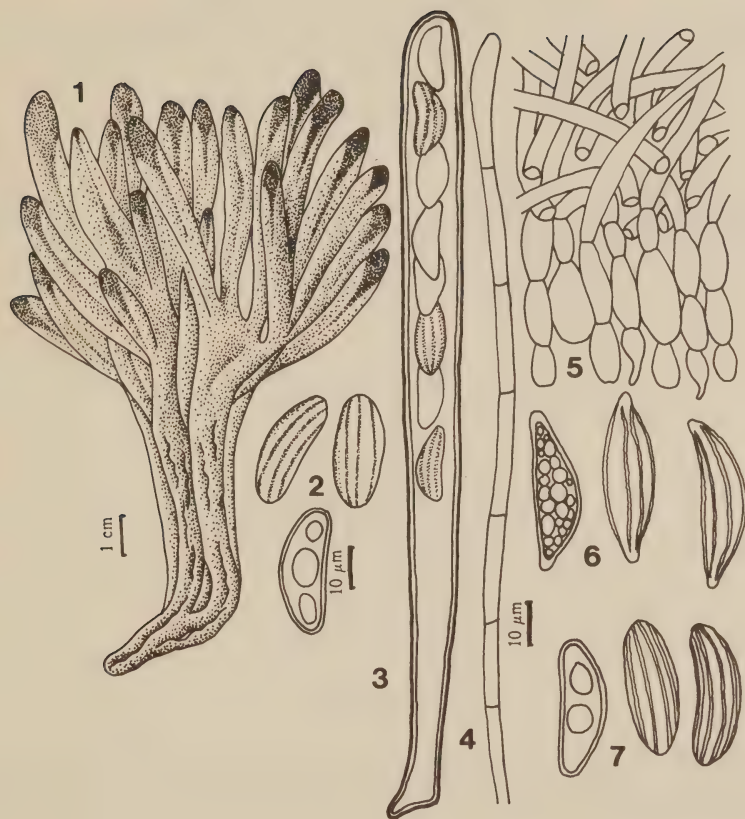
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Figs. 1-7. *Wynnea* species from Mexico. 1-5: *W. macrotis*. 1: apothecium, from a rehydrated specimen. 2: ascospores. 3: ascus with ascospores. 4: paraphyses. 5: ectal excipulum and a portion of medullary excipulum (all from **Guzmán 24397**). 6: *W. americana*, ascospores (from **Pérez-Ortiz 1074**). 7: *W. gigantea*, ascospores (from **Otani 3266**).

STUDIES ON NORTH AMERICAN CORTINARIII I. NEW AND INTERESTING TAXA FROM THE GREATER YELLOWSTONE AREA ¹

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Abstract: 19 taxa of *Cortinarius* subgen. *Phlegmacium* and *Telamonia* are described or discussed. Of these *Cortinarius albobrunnoides*, *C. aurora*, *C. cephalixoides*, *C. subfoetens*, *C. flavaurora*, *C. resinaceus* and *C. pseudobovinus* are described as new species, *C. elegantior* var. *americanus* is described as new variety and *C. fulvoochrascens* f. *marginatus* and *C. umidicola* f. *caeruleus* as new forms. *C. pseudoarquatus* A.H.Smith is regarded as synonym of *C. fulvoochrascens* R.Hry. Seven European species and one variety are recorded for America, three of them are more widely distributed there, but have been mostly confused with other taxa (*C. umbilicatus*, *C. papulosus* and *C. fulvoochrascens*).

Key words: *Cortinarius*, *Phlegmacium*, *Telamonia*, Wyoming.

Studies of the *Cortinarius* flora of the Greater Yellowstone region soon

¹Part III in Sydowia 45(2):275-306, 1993

video prints using a Sony UP 9120 video printer. Dried material was mounted in 3% KOH solution for microscopic study or occasionally in ammonia for study of gelatinized structures.

A30% KOH solution was used for macrochemical reactions.

Measurements in the Latin diagnosis and English description may sometimes differ, since measurements for the Latin diagnosis are only from the type collection, while the English descriptions are supplemented by data from other collections. Indication of lamella density : L = total number of lamellae reaching the stipe and l = number of lamellulae between two lamellae. Comparison of the lamellae width with the thickness of the pileus context was made about half the radius of the pileus.

Abbreviations in spore measurements: S = standard deviation (n=31), Q = quotient of spore length through spore width, V = spore volume.

Color codes used include: R = Ridgy (1912), Caill = Cailleux (1881), EXPO = Cailleux A., G. Taylor, Code expolaire, Mu = Munsel (1975) and Met = Kornerup & Wanscher (1967), for determination of sporeprint colors occasionally Moser, Kleine Kryptogamenflora IIB/2.

Data & discussion

Cortinarius subgenus *Phlegmacium* (Fr.) J.G.Trog

Section *Phlegmacium* subsect. *Multiformes* Hry. ex Brandr. & Melot

Cortinarius (*Phlegmacium*) *albobrunnoides* Mos. & McKnight spec.nov.
(Fig. 2, 25)

Pileo 3.5-7.5 cm lato, convexo, ad marginem subflexuoso, margine primo involuto, glutinoso, aurantio-brunneo obscuriore rufo-brunneo maculato vel striato, *Tricholoma albobrunneum* vel *batschium* in mentem revocante, lamellis argillaceis, griseo-brunneis, saepe ferrugineo-brunneo maculatis, emarginatis, confertis, 7-9 mm latis, stipite bulbo marginato praedito, 5-6 cm longo, apice 14-15 mm, bulbo 17-25 mm crasso, pallide ochraceo, margine bulbi albo, mycelio basali sulphureo, carne alba, inodoro, sapore miti. Sporis 10-12(-13.5) x 8-8.5 μ m, amygdaliformibus usque sublimoniformibus, verrucosis.

Habitatio: in silvis coniferis subalpinis (*Picea engelmannii*, *Pinus contorta*, *Abies lasiocarpa*), holotypus IB 87/186, via "Flagstaff", Teton National Forest, Wyoming 09.VIII.1987.

P i l e u s 3.5-9 cm across, convex, margin at first involute, sometimes undulate, glutinous to viscid, the ground color pale ochraceous (Mu 10YR 8/4-8/6, 7.5YR 8/6; Caill 45M to 57N, also 50L, 49L) with reddish brown spots and the disc completely reddish brown (Mu 7.5YR 6/6-6/8, Caill 59P, 40N-P, 45P), ground color sometimes darker, orange-brown (Caill 40N and 59N), disc and often radial streaks darker reddish brown (Caill 39S to 37S), sometimes spotted, not innately fibrillose, pruinose centrally and occasionally elsewhere. The color is similar to certain *Tricholoma* spp. e.g. *albbrunneum* and *batschii*.

L a m e l l a e argillaceous, gray-brown (Caill 70M) or slightly darker, near to Mu 10YR 6/6, finally Sayal Brown (R) to Tawny Olive (R), sometimes spotted

revealed a relatively high degree of similarity with the flora of montane and subalpine forests in Europe, particularly the Scandinavian Mountains and the Alps. This observation suggested the advisability of extending these studies over a longer period of time and also beyond Wyoming to other parts of North America. It also necessitated a thorough revision of all available type material and other interesting collections, particularly those of C.H.Kauffman and A.H.Smith. A detailed presentation of the revisions of collections in various herbaria will be given in one or two later parts of this series. Some results, however, will be discussed in pertinent places in this and other parts of the series. The first two parts will present descriptions of some new species and interesting European species, which are recorded for the first time for North America. Later papers will deal with specific taxonomic or ecological groups of *Cortinari*. A book with keys and colored plates is planned.

Collecting Areas.

The collections treated in this report are from 1) Yellowstone National Park, 2) Teton National Park, 3) Rockefeller Highway, 4) Teton National Forest in the vicinity of Jackson Hole and east of Teton National Park up to Togwotee Pass, 5) Shoshone National Forest in the vicinity of Falls Camp ground and the Brooks Lake area and 6) in the vicinity of the Union Pass in the Wind River Mountains.

The geology of this area is highly diversified, and since many *Cortinari* prefer calcareous soils certain localities proved particularly productive (Moser, McKnight & Sigl 1995). The richest areas were between Turpin Meadow Lodge and Fourmile Meadow, along Flagstaff Road and Creek in Teton National Forest, the Brooks Lake area and Falls Campground in the Shoshone National Forest, and the area around Union Pass in the Wind River Mountains.

The type of vegetation also has a great influence on species richness (Moser, McKnight & Sigl 1995). Particularly productive are spruce forests (*Picea engelmannii* Parry, *P. pungens* Engelmann, often mixed with *Abies lasiocarpa* (Hook.) Nutt., *Pseudotsuga menziesii* (Mirbel) Franco. *Pinus contorta* Dougl. is also often mixed with *Picea* or *Abies*. Pure pine forests are generally dryer and the pattern of diversity in the accompanying *Cortinarius* species is much less.

Methods

When harvested, each collection of *Cortinarius* basidiomata was wrapped separately in aluminum foil or occasionally in waxed paper. Aluminum foil is preferred as this maintains true natural colors and other essential fresh characteristics better and longer. The collections were transported in cool boxes when ever possible and kept in the laboratory refrigerator until color photographs were taken. Detailed written field notes were prepared the same or the following day. For the more interesting taxa Vera McKnight made pencil sketches and watercolor paintings as soon as possible. A preliminary microscopic examination was done to check basidiospores and critical structures which do not revive well in KOH or ammonia. In most cases the fluorescence under UV-light (354 nm) was also noted on fresh basidiomata. A detailed microscopic study was carried out in Innsbruck with an Olympus BHS2 microscope, a Sony SSC-C350P color video camera and a Sony Kx14CP1 monitor. Basidiospore measurements for statistical purpose were made from

with rusty yellow-brown dots, narrowly to broadly emarginate, crowded, $L=80-100$, $l=1.3-5$, $15-17/\text{cm}$ at the margin, $7-9 \text{ mm}$ wide (= 1-2 times thickness of pileus context), edges slightly eroded.

St i p e $5-7 \text{ cm}$ long, $14-35 \text{ mm}$ thick, the bluntly marginate bulb $17-40 \text{ mm}$ wide, pale ochraceous (Caill 71K) to whitish (with some brass colored spots), bulb at the margin white, below with lemon yellow mycelium.

C o n t e x t whitish. Odor not distinctive, taste mild, slightly astringent.

S p o r e p r i n t dark rust-brown as in *C. elegantior*, (Caill 55P to 53R), Moser B8.

C h e m i c a l c h a r a c t e r s: KOH on pileus surface gray-brown, no reaction on the context. Under UV pileus, stipe and lamellae violet with some yellow spots, lower part of stipe more yellowish, mycelium yellow to orange.

M i c r o s c o p i c c h a r a c t e r s: Spores $10.1-13.0 \times 6-7 \mu\text{m}$, mean 12.0 ($S = 0.61 \times 6.6$ ($S = 0.27$), $Q = 1.8$, $V = 214-316$, mean 269 ($S = 24.14$), almond-shaped, verrucose (in coll. $91/237$ the basidiospores were $11.8-14.5 \times 6.2-7.7 \mu\text{m}$); basidia $35-40 \times 9.8-10.5 \mu\text{m}$, 4-spored, clavate, with basal clamp connections. Pileipellis with gelatinous surface layer, hyphae $3-4.5 \mu\text{m}$ thick, hyaline to slightly yellowish, irregularly arranged, some with encrustations. Epicutis of repent hyphae with brownish wall pigments and encrusted surfaces, $7-10 \mu\text{m}$ wide. No cystidia.

H a b i t a t: under *Picea engelmannii* and *Pinus contorta* in subalpine forests.

Collections examined: **Yellowstone National Park**: $89/242$ (IB) trail to Turbid Lake under *Pinus contorta*, $16-08-1989$. **Wyoming**: $87/186$ (holotype IB, isotype BRY), Flagstaff Road about 1 mile from east end, Teton National Forest, $09-08-1987$; $87/275$ (IB, BRY), Union Pass, Lake of the Woods, Teton National Forest, leg. V. McKnight, $21-08-1987$; $89/298$ (IB, BRY), Union Pass, trail to Union Peak, Shoshone National Forest, $21-08-1989$; $91/137$ (IB, BRY), about 5 miles north of Union Pass, Shoshone National Forest, $13-08-1991$; $91/270$ (IB, BRY), Union Pass, Lake of the Woods, Teton National Forest, leg. H. Thiers, $15-08-1991$; $91/261$ (IB, BRY), same area and date, leg. M. Moser; **Washington**: $89/479$ (IB), Chelan Co., Rainy Pass, under *Abies lasiocarpa* and *Picea engelmannii*, leg. M. Moser, $12-09-1989$. **Utah**: observed also in Utah (K. McKnight).

C o m m e n t s: Few other species with bright yellow basal mycelium are known e.g. *C. sulphureomyceliatus* Mos. & Hk. from Patagonia and *C. haasii* Mos. and some related taxa from Europe. However, neither of these species seems to have a close relationship to *C. albobrunnoides*.

Sectio *Aurantiovelati* Moser & Ammirati sect. nova

Velo aurantiaco, KOH ope reactionem purpuream praebente, sporis amygdaliformibus vel sublimoniformibus.

Typus sectionis : *Cortinarius aurora* Mos. et Ammirati

1. Occurring in subalpine conifer forests. Pileus dark brown, lamellae argillaceous or only with a faint lilac tinge, stipe whitish, margin of bulb fringed with orange to salmon orange veil at first. Basidiospores $10.3-14.1 \times 6.8-8.3 \mu\text{m}$

C. aurora Mos. & Ammirati

1* Occurring in hardwood forests in lowlands. Known only from Michigan.....2

2. Pileus $4.5-7.0 \text{ cm}$, brilliant yellow often with orange streaks. Lamellae pale lilac,

lilac-brown to dull lilac. Stipe pale vinaceous lilac, bright yellow towards the base, veil orange. Basidiospores $10.0-12.5 \times 6.3-7.2 \mu\text{m}$.

C. amnicola A.H.Smith

2*. Pileus 3-7 cm, vermillion-red to orange-fulvous. Lamellae caesious to pale drab, then argillaceous-cinnamon. Stipe pale straw-yellow to whitish, context citron, the marginate bulb covered by vermillion-red veil. Spores $14.7-18.3 \times 7.0-8.5 \mu\text{m}$

C. rubens Kauffm.

Cortinarius (Phlegmacium) aurora Moser & Ammirati spec. nov.

(Fig. 1 a,b, 3, 26)

Pileo 5-10 cm lato, hemisphaerico, dein convexo usque applanato, saepe irregulariter gibboso, ad marginem involuto, glutinoso, obscure brunneo sed praecipue marginem versus e velo aurantiaco oblecto et superficie interdum variegato, lamellis argillaceis, dein griseo-sepiaceis, emarginatis, acie serrulata, confertis, 7-8 mm latis, stipite 6-8 cm longoa 17-22 mm crasso, bulbo marginato 20-50 mm lato, albedo, margine bulbi e velo aurantiaco vel salmoneo primo magnifice ornato, carne albida, in aereo decolorante flavida, inodoro, sapore miti. Sporis $10.3-3.7 \times 6.8-8.3 \mu\text{m}$, $Q = 1.65$, amygdaliformibus usque sublimoniformibus, verrucosis. Basidiis tetra- vel bisporigeris, absque cheilocystidiis, fibulis praesentibus. In cuticulam KOH ope reactionem purpureo-violaceam praebente.

Habitatio in silvis coniferis montanis (*Picea engelmannii*), holotypus 89/227 IB, otypus JFA 9938, WTU et BRY), in silva prope "Fourmile Meadows", Wyoming, Teton National Forest, leg. J. Ammirati et M. Moser, 14.VIII.1989

P i l e u s 5-11 cm across, hemispheric or pulvinate in young buttons, then convex and with disc becoming flattened to applanate with age, often irregularly gibbose, margin inrolled at first, later often curved, surface glutinous, ground color dark-brown, Caill 35S, 47R, S47, S49, sometimes paler, Caill 57P to 57N, P49, often only in a few places, covered by an orange universal veil, which causes the margin to be completely orange, Capucine Orange to Mikado Orange (R), paler over the disc where the veil thins out, Caill 65L or even paler, veil sometimes fading and sometimes the entire pileus appears paler brown, Caill 67M to 69 M, near the margin occasionally with yellowish areas, Caill 77K, innately fibrillose or surface appearing variegate due to the expanded veil.

L a m e l l a e in buttons sometimes grayish with a faint lilac cast, Pale Quaker Drab (R), sometimes only argillaceous, later gray-brown, milk-coffee-brown, in Caill near to 70M but slightly darker, emarginate, edges eroded, close, $L = 90-100$, $l = 3$, 11-12/cm at the margin, 7-9 mm broad (= 1-2 x thickness of pileus context).

S t i p e 6-8-(14) cm long, 10-28 mm thick, the marginate bulb 30-50 mm across, solid, whitish, rarely slightly grayish or lilac, the bulb with a distinct rim, somewhat oblique to flattened or depressed above bulb, the margin of the bulb fringed by the veil which is orange to salmon orange in buttons, but may later fade to yellowish, bulb underneath white to yellowish, mycelium in soil whitish.

C o n t e x t solid, firm, to more or less 15 mm thick at the disc, whitish or pale lilac, in young basidiomata also somewhat watery grayish, in stipe lilac, Grayish Lavender (R), discoloring yellow when exposed to air for some time. Without distinctive odor, somewhat fungoid, taste mild.

M i c r o s c o p i c c h a r a c t e r s: Basidiospores $11.7-14.1 \times 6.8-8.3 \mu\text{m}$, means 12.6 ($S = 0.52$) $\times 7.6$ ($S = 0.45$) μm , $Q = 1.7$, $V = 322-480$, mean 404 ($S =$

37.4), almond-shaped to sublimoniform, verrucose; Basidia 4-, occasionally 2-spored, 36-43 x 9-11 μm , with basal clamp connections. Without cheilo- and pleurocystidia. Hyphae of the veil 2-3 μm thick, with rather large clamp connections, pink in 3 % KOH; cortina hyphae 2-2.4(-3) μm , hyaline, with a fine granular surface.

C h e m i c a l r e a c t i o n s : KOH on pileus cuticle immediately deep purplish violet, Pomgranate Purple (R), soon becoming deep brown-red, on the more brown parts of the pileus the reaction is more red, the margin of the bulb, where covered by the veil, gives the same striking reaction. On the context a pale violet-purplish reaction may be observed. NH_4OH (vapor) colors the cuticle bright ink-red. Under UV on pileus a bright red (cinnabar red), on stipe and context violet fluorescence. The context, when exposed to the air for some time gives a yellow fluorescence (this can also be observed on the underside of the bulb). This reaction can also be seen in exsiccata. Under the fluorescence microscope cross-shaped crystals can be seen within the hyphae of the veil and the epicutis which fluoresces red like glowing coals. Chromatographically, only two anthraquinonic pigments in rather weak concentration could be traced.

H a b i t a t : In subalpine conifer forests under *Picea engelmannii*, *P. pungens*, *Pseudotsuga menziesii*, several times observed on litter of ground-squirrel heaps, at times nearly buried, gregarious to cespitose, sometimes in more or less complete fairy rings.

Collections examined. **Wyoming:** 89/227 (IB holotype, isotype JFA 9938, WTU and BRY), Fourmile meadow, Teton National Forest, 14-08-1989 ; 89/228 (IB, part in BRY), same area and date; 89/288 (IB), 09-08-1989, near Togwootee Lodge, Teton National Forest; 91/410 (IB), 91/411 (IB), 91/412 (IB) and JFA 10355 (WTU) all Fourmile Meadow, 03-09-1991; IB 91/337 above Turpin Meadow, under *Picea engelmannii*, *P. pungens*, *Pseudotsuga menziesii*, Teton National Forest, leg. V. McKnight 26-08-1991; BRY 91091207, near Snake River Picnic Grounds, Grand Teton National Park, leg. K.H. McKnight, 09-09-1991.

C o m m e n t s : The orange veil, the purple KOH reaction, the type of pigmentation are a striking combination of characters. The only closely related species seems to be *C. amnicola* A.H. Smith. As judged from the description and type study it has similar characters and belongs in the same group.² We suspected that *C. rubens* Kauffm. would also fit into this group but the type of pigmentation seems different and the spores are much larger. In Europe *C. aurantiobasalis* Bidaud has been recently described with an orange veil around the bulb, while the veil on the pileus is described as white but becoming yellow (Bidaud et al. 1993). It, however, has blue colors on stipe, and partly on the pileus and currently would be assigned to the Coerulescentes. The chemical characters of these taxa should be investigated more carefully.

² Smith (1944) indicates the number 15308 for the holotype, the holotype in the herbarium at Ann Arbor, however, bears the number 15381 !

Section *Cliduchi* (Fr.) Sacc.

Cortinarius (Phlegmacium) fraudulentus Britz. (1885)
(Fig 4, 27)

Pileus 2.5-6(-8) cm across, hemispheric to convex, margin involute at first, somewhat viscid but soon becoming dry, usually radially innately fibrillose, ochraceous brownish, Caill 71K to 69L, center sometimes slightly darker, margin whitish due to a covering by the universal veil, a white pruinose covering sometimes present over all or part of the pileus surface.

L a m e l l a e rather pale, ochraceous at first, later milk-coffee-brown, Tawny Olive (R), thick, distant, adnate to emarginate, edges entire to slightly eroded, very wide, 8-15 mm.

S t i p e 6-10(-12) cm long, 10-25 mm thick above, sometimes with slightly or distinctly bulbous base up to 35 mm across, white or whitish, covered below the cortina by white veil which can be floccose at first, base often bluntly pointed and distinctly to slightly asymmetric.

C o n t e x t whitish to pale ochraceous. Odor strongly of greencorn (earthy), taste mild.

Under UV the veil is pale yellowish both on pileus and stipe, otherwise all parts bluish-violeaceous.

M i c r o s c o p i c c h a r a c t e r s : Basidiospores $11.3-13.7 \times 6.7-8 \mu\text{m}$, mean 12.2 ($S = 0.47$) $\times 7.2 \mu\text{m}$ ($S = 0.09$), $Q=1.7$, vol = 279-420, mean 337 ($S = 32.5$), almond-shaped to sublimoniform, verrucose. Basidia $40-45 \times 9.5-10 \mu\text{m}$, 4-spored, clavate. Without cystidia. Gelatinous layer on pileus surface poorly developed, hyphae $5-7 \mu\text{m}$ thick, with clamp connections, epicutis hyphae $6-9(-10) \mu\text{m}$, walls pale yellowish. Veil hyphae from stipe $4-5 \mu\text{m}$, with clamp connections. In Melzer reagent strongly dextrinoid encrustations and interhyphal amorphous masses can be observed.

H a b i t a t : Under *Picea engelmannii* and *P. pungens*.

Collections examined: **Wyoming**: IB 87/155, BRY (=KHM 87080501), above Turpin Meadow, Teton National Forest, 05-08-1987, leg. M.Moser & V. McKnight; BRY 87081309, same area, leg.M.Moser, 13-08-1987. **California**: IB 91/580, Patrick's Point State Park, Humboldt Co., under *Picea sitkensis*, leg.M.Moser 27-11-1991.

C o m m e n t s : *Cortinarius fraudulentus* has been observed several times in the area. There are, however, macroscopically rather similar taxa but with different spore sizes. The species is common in European spruce forests on calcareous soils. Melot (1986) thinks that this might be the same as *C. argutus* Fr. In fact, the two species are closely related but differ in habitat, spore size and thickness of the lamellae. *Cortinarius argutus* grows with hardwood trees. The odor of greencorn is much more pronounced in *C. fraudulentus*. Melot (1986) has described a vine-red discoloration of the context, which may appear even after prolonged time of 12-24 hours. From our observations this discoloration varies in intensity and in many collections is totally lacking. In our American collections we did not observe this character. *C. paracephalixus* Bohus (1976) shows the same type of vine-red discoloration on the context, has the same odor but not the distant lamellae and grows under deciduous trees. The spores are of the same size and type.

Key to species of stirpe "Vitellinopes"

1. Universal veil forming gray-brown to violaceous brown appressed belts or patches on the lower half of the stipe. Pileus ochraceous brown, disc darker brown. Spores $8.3-10.5 \times 4.7-5.7 \mu\text{m}$ *C. papulosus* Fr.
- 1*. Universal veil with olivaceous, olive yellowish, yellowish, greenish or ocher brown colors 2
2. Pileus ocher brown with olivaceous tinge. Stipe pale yellowish with yellow patches of veil which become finally fuscous. Spores $9.3-12.7 \times 5.9-7.7 \mu\text{m}$ *C. cephalixoides* Mos. & Thiers
- 2*. Pileus pale ocher- to olive-brown or even ochraceous greenish. Stipe with olivaceous, olive-yellowish to ochraceous brown veil remnants. Spores $9-10.5 \times 4.7-5.2 \mu\text{m}$ (Observed in Wyoming but not treated in this paper) *C. cephalixus* Fr.

Cortinarius (Phlegmacium) papulosus Fr.(1838)
(Fig.5, 28)

The specimens collected at Union Pass, Windriver Mountains, correspond perfectly to European material in all characters. To our knowledge it is the first American record. Therefor we provide a brief description.

P i l e u s 3.5-5 cm across, convex, margin at times somewhat undulate, inrolled at first, viscid, grayish brown to pale cocoa brown, near Cinnamon Brown (R), center darker, near Sayal Brown or even Mikado Brown (R), sometimes slightly granulose on the disc and somewhat innately fibrillose, especially toward the margin.

L a m e l l a e argillaceous to gray-brown, emarginate, edges serrulate, crowded, L=100-110, l=1-3, 4-5 mm broad (equals the thickness of the pileus context)

S t i p e 3.5-5.0 cm long, apex 6-10 mm thick, the clavate base 12-20 mm thick, apex nearly whitish, downwards slightly brownish and covered by a gray-brown to fuscous veil which can form incomplete belts or patches.

C o n t e x t whitish. Without distinctive odor, taste mild.

M i c r o s c o p i c c h a r a c t e r s: Basidiospores $8.3-10.7 \times 4.5-5.7 \mu\text{m}$, mean 9.2 ($S=0.45$) $\times 5 \mu\text{m}$ ($S = 0.28$), $Q=1.8$, $V = 95-179$, mean 125 ($S = 10$), almond-shaped, only slightly verrucose. Basidia $34-38 \times 8.5-9.0 \mu\text{m}$, 4-spored, clavate. Pileipellis with gelatinous layer, hyphae $2.5-4 \mu\text{m}$ wide, on surface more or less repent, below irregularly ascending, basic layer repent, epicuticular hyphae $5-8 \mu\text{m}$, walls pale to dark brown. Clamp connections present.

C h e m i c a l c h a r a c t e r s: KOH dark gray-brown on pileus surface, pale gray-brown on the context. Under UV purplish on pileus, lamellae and upper part of stipe, yellow spots on the lower half of the stipe.

H a b i t a t: Under conifers.

Collections examined: **Wyoming**: under *Picea engelmannii*, 87/278 (IB), Union Pass, Lake of the Woods, about 2700 m, Teton National Park, leg. K.& V. McKnight, 21-08-1987; 87/293 (IB, BRY), near trail to Arizona Lake, Teton National Forest, leg.M.Moser, 23-08-1987. **California**: under *Tsuga heterophylla*, *Pseudotsuga menziesii*, *Pinus muricata*, *Arctostaphylos manzanitae*, 91/658 (IB) Russian Gulch State

Park, 4.5 miles east of Mendocino, leg. H. Thiers, 05-12-1991 ; 91/677a (IB), Caspar Little Lake Road, about 4.5 miles from Mendocino, 06-12-1991

C o m m e n t s: *Cortinarius papulosus* is easily recognized by the gray-brown to fuscous universal veil and the brown pileus surface with dark center, resembling from above *Hygrophorus discoides*, a character already stressed by Fries (1863).

Cortinarius (Phlegmacium) cephalixoides Moser & H.D.Thiers spec. nov.
(Fig.7, 29)

Pileo 4-5 cm lato, convexo, interdum flexuoso, viscido, ochraceo-brunneo, leviter olivaceo tincto, margine ochraceo et saepe viridulo maculato, leviter innato-fibrilloso, disco plus minusve granuloso, lamellis argillaceis, acie serrulata, confertis, adnatis usque subemarginatis, 4-5 mm latis, stipite clavato-bulboso, 5-6 cm longo, apice 18 mm, basi usque 25 mm crasso, pallide flavido, primo e velo flavido ornato, dein fuscuscente, cortina flava, mycelio basali flavo, carne pilei albida, stipitis laete flava, odore forte malis immaturis simili, sapore miti, cuticula KOH ope reactionem plus minusve viridem praebente. Sporis 11-12 x 6-7 μm , amgydaliformibus, valde verrucosis.

Habitatio: in silvis coniferis (*Picea engelmannii*), holotypus 87/188, via Flagstaff, Teton National Forest, Wyoming, leg. H.D.Thiers, 09.VIII.1987, in herbario IB conservatus est.

P i l e u s about 4-5 cm across, convex-undulate, glutinous to viscid, ocher brown with an olivaceous hue, approximately Caill 60P to 65P but paler, margin ochraceous, Caill 69M, 67M, with some greenish spots at the margin, finely innately fibrillose, disc somewhat granulose.

L a m e l l a e argillaceous, Caill 70L to 70M, edges eroded, crowded, L=130-140, l=3, 20/cm at the margin, broadly adnate to slightly emarginate and with decurrent tooth, 4-5 mm broad (corresponds to about the thickness of the pileus context).

S t i p e about 5-6 cm long, 18 mm above, base 25 mm thick, clavate-bulbous, pale yellowish (Met 2A2-3) with patches of a yellow, later fuscous, scaly veil below the yellowish cortina. Basal mycelium yellow.

C o n t e x t whitish in the pileus, bright yellow in the stipe (Met 1A3-4), darker in the apex. Odor strongly of immature apples, taste mild, somewhat of grass (slightly acid).

C h e m i c a l r e a c t i o n s: KOH on pileus epicutis grayish green, on pileus context, after some time, turning greenish, also green in the base of the stipe. NH_4OH no reaction. Under UV pileus and stipe purplish, context in the stipe more or less orange.

M i c r o s c o p i c a l c h a r a c t e r s: Basidiospores 9.3-12.7 x 5.7-7.7 μm , mean 10.5 (S = 0.77) x 6.5 μm (S = 0.32), Q = 1.6, V = 168-389, mean 236 (S = 39.7), almond-shaped, coarsely verrucose. Basidia 38-40 x 8.5-9.0 μm , 4-spored, clavate. Pileipellis with a gelatinous surface layer composed of irregularly arranged, narrow hyphae, 3-4 μm wide. Epicuticular hyphae radially arranged, 6-8-(10) μm thick, walls pale brown, hypodermium hyphae more or less hyaline, 12-15 μm thick, hyphae of the cortina 3.5-4.5(-5) μm , hyaline. Clamp connections present but relatively rare.

H a b i t a t: in subalpine forests under *Picea engelmannii*.

Collections examined: **Wyoming:** 87/188 (IB holotype, isotype at BRY) about 1.5 miles from eastern end of Flagstaff Road, Teton National Forest, leg. H.D.Thiers, 09-08-1987; 87/195 (IB, BRY), same area but different site, leg. H.D.Thiers, 10-08-1987.

C o m m e n t s: *Cortinarius cephalixoides* clearly belongs in the group of *C. cephalixus*, but differs from all taxa of this group by the yellow mycelium, yellow colors in the context and the combination of pileus colors of *C.cephalixoides*.

Section *Glaucopodes* Konr. & Maubl. ex Brandrud & Melot

Cortinarius (Phlegmacium) subfoetens Moser & McKnight spec. nov.
(Fig.6, 30)

Pileo 4-13 cm lato, convexo, dein applanato, interdum disco depresso, glutinoso, duro, margine diu involuto, colore pallide ochraceo-brunneo, discum versus luteo-brunneo (Russulam foetentem in mentem revocante), numquam innato-fibrilloso, lamellis argillaceis, demum obscurioribus, emarginatis, acie serrulatis, confertis, 5-8 mm latis, stipite 5-10 cm longo, apice 13-35 mm, bulbo 24-45 mm crasso, bulbo pro ratione angusto, interdum indistincte obtuseque marginato, durissimo, pallido, velo albo, carne pallida, dura, odore maydis recentis vel terrae simili, sapore miti. Spor. 7.2-9.3 x 4.3-5.7 μm , ellipsoideis usque amygdaliformibus, verrucosis. Cuticula KOH ope reactionem rufo-brunneam praebente.

Habitatio in silvis coniferis (*Picea engelmannii*) holotypus 89/307, supra pratum "Fourmile Meadows" a meridiam viam, Teton National Forest, Wyoming, leg. K.H.McKnight, 21.VIII.1989, in herbario IB, isotypus in BRY conservatus est.

P i l e u s 4-13 cm across, convex, later applanate, center sometimes slightly depressed, margin involute, remaining so for a rather long time, very hard and compact, glutinous, color near margin pale ochraceous brownish, near Warm Buff (R), Mu 2.5Y7/4, towards the center more yellow-brown, Caill 60N, 57N, sometimes somewhat irregular and spotted, the colors reminiscent of Russulas of the *Foetentinae*, not innately fibrillose.

L a m e l l a e argillaceous at first, then pale gray-brown, Caill 70L to 69M, later darker, 70M, Avellaneous (R), emarginate, edges somewhat eroded, crowded, L = about 100, l = 1-3, 13-14/cm at the margin, 5-8 mm broad (equals the thickness of the pileus context)

S t i p e 5-10 cm long, 13-35 mm thick, with a rather narrow, obtusely marginate, sometimes indistinct bulb which is 24-35 mm broad, very hard and solid, pallid, Light Buff (R), the veil whitish.

C o n t e x t pallid, Light Buff (R), hard. Odor of greencorn or earthy, sometimes rather strong, taste mild.

C h e m i c a l r e a c t i o n s: KOH reddish brown on the pileus cuticle, pale brownish in the context. Under UV red mixed with yellow on the pileus surface and stipe, pale lilac on the context.

M i c r o s c o p i c c h a r a c t e r s: Basidiospores 7.2-9.3 x 4.3-5.7 μm , mean 7.9 (S = 0.51) x 4.9 μm (S = 0.29), Q = 1.6, V = 70.5-157.8, mean 99.5 (S = 17.4). Basidia 30-35 x 7-8 μm , 4-spored, clavate. Gelatinous layer on pileus surface relatively thin, hyphae 4-5.3 μm wide, more or less repent, hyaline, with clamp connections, epicuticular hyphae repent, 8-9 μm , walls yellowish, hypodermium subcellular to cellular, elements 15-26 μm wide, cortina hyphae 3-4.5 μm , hyaline,

with clamp connections.

H a b i t a t : Clustered under *Picea engelmannii* on narrow, rounded ridge at roadside that had been previously disturbed in highway construction.

Collection examined: **Wyoming:** 89/307 (IB holotype, BRY isotype) near Fourmile Meadow but south of the Highway, Teton National Forest, leg. K. McKnight, 21-08-1989.

C o m m e n t s : *Cortinarius subfoetens* is well characterized by the coloration and size of the basidiomata and similarity from above with *Russula foetens* and related species. The small spores, distinctive odor and type of KOH reaction of the pileus cuticle suggest a relationship with the *Glaucopus* group. However, it differs from this group by the lack of any bluish colors both on the lamellae and stipe and the absence of an innately fibrillose pileus cuticle. There are in Europe taxa of the *Glaucopus* group without blue colors e.g. *C. glaucopus* var. *acyaneus* Mos. The odor of greencorn occurs in other American collections in the *Glaucopus* group (unpublished).

Stirpe *Elotus*

Cortinarius (Phlegmacium) elotoides Mos. & McKnight spec. nov.
(Fig. 8, 31)

Pileo 3-9.5 cm lato, hemisphaerico, dein convexo, margine involuto, glutinoso, cum coloribus mixtis, olivaceo-viridis, olivaceo-brunneis, saepe maculato, interdum paulo plus flavis, saepe pro parte oblecto e velo albido-ochraceo, lamellis primo pallide lilaceis, dein pallide avellaneis, griseo-brunneis, adnatis usque emarginatis, confertis, 5-8 mm latis, stipite bulbo obliquo obtuseque marginato, 4-6 cm longo, apice 12-23, bulbo 20-35 mm crasso, albido usque pallide bubalino, carne alba, albida, aetate ochracea. Sporis 11.3-14 x 6.7-8.3 μ m, amygdaliformibus sublimoniformibusve, verrucosis, basidiis tetrasporigeris, 39-42 x 9.5-10 μ m, clavatis, fibulis praesentibus.

Habitatio in silvis subalpinis, sub *Picea pungens*, *P. engelmannii*, *Pseudotsuga menziesii*, holotypus 87/60 supra Turpin Meadow, Teton National Forest, Wyoming, 23.VII.1987 in herbario IB conservatur.

P i l e u s 3-10 cm across, at first hemispheric, then convex with involute margin, finally plano-convex, glutinous, colors a mixture of olivaceous greenish and dark olive-brown tinges, often maculate, (Caill 67N, 67P, 65P, 75N, 77N), with paler spots (77L, 77K), sometimes the pale areas more yellowish (65N and even 80N), occasionally paler overall, often partially covered by pale whitish ochraceous veil remnants.

L a m e l l a e at first often slightly lilac, near Vinaceous Gray (R), later gray brownish, between Sayal Brown and Wood Brown (R), Caill about 53M or paler, edges eroded, adnate to broadly emarginate, crowded to very crowded, L=120-150(-170), l=3, 19-25/cm at the margin, 5-8 mm broad (equaling the thickness of the pileus context).

S t i p e 4-6.5 cm long, 12-23 mm thick at the apex, 20-35 mm across the obliquely and obtusely marginate bulb, white to light buff, margin and underside of the bulb pallid, later more ochraceous from the veil, mycelium white. Veil white to whitish, turning ochraceous with age.

C o n t e x t white to whitish, slightly marbled in the stipe, sometimes slightly lilac in the pileus, with age becoming yellowish in the base of the stipe. Odor

somewhat of radish or raw potatoes at least when cut, taste mild.

C h e m i c a l c h a r a c t e r s: KOH yellow-brown to orange-brown on the pileus surface, no reaction on the context. Under UV the pileus appears blue to purplish with some yellow spots (veil remnants ?), stipe and lamellae reddish violet, bulb violet underneath and partly yellow, context violet.

M i c r o s c o p i c c h a r a c t e r s: Basidiospores $11.3-14 \times 6.7-8.3 \mu\text{m}$, means $12.6 (S = 0.65) \times 7.4 \mu\text{m} (S = 0.36)$, $Q = 1.7$, $V = 263-484$, mean 357 ($S = 46.3$), almond-shaped to sublimoniform, verrucose. Basidia $39-42 \times 9.5-10 \mu\text{m}$, 2-4-spored, clavate, with basal clamp connections. Hyphae of the cortina $3-4 \mu\text{m}$. Pileipellis with a gelatinous layer on surface with repent, $3.5-5 \mu\text{m}$ wide hyphae and in the basal layer, mixed with some ascending hyphae in between, with clamp connections. The proper epicuticular hyphae $7-10 \mu\text{m}$ wide, walls pale yellowish.

H a b i t a t: Under *Picea pungens*, *P. engelmannii* and *Pseudotsuga menziesii* in subalpine forests.

Collections examined: 87/60 (holotype IB), woods above Turpin Meadow, Teton National Forest, 23-07-1987; 87/165 (IB), same area, 05-08-1987; 87/40 (IB) Falls Campground, Shoshone National Forest, 22-07-1978; 98/188 (IB) near Fourmile Meadow, Teton National Forest 07-08-1989; 89/209 (IB) and JFA 9912, same area 11-08-1989; 89/278 (IB) and JFA 9983, same area, 18-08-1989; 91/169 (IB), near Lodge at Turpin Meadow, Teton National Forest, 03-08-1991.

C o m m e n t s: *Cortinarius elotoides* is rather common in the Greater Yellowstone Area and easily recognized by the dingy, mixture of brown colors with a strong olivaceous tinge, the large spores and the radish odor. It is related to the European *C. elotus* Fr. The latter has smaller spores $10-12 \times 6-7 \mu\text{m}$, the pileus has olive-brownish to brownish innate fibrils or maculations on a straw-yellow ground color, the lamellae are rather variable in color (whitish, gray, sometimes with lilac tinge, to wax yellowish or argillaceous), the stipe is whitish to violaceous and the odor slightly of raw potatoes.

Cortinarius (Phlegmacium) fulvoochrascens Henry (1943)
(fig. 9-14, 32)

Syn. *Cortinarius fuscomaculatus* J.Schff. (1947) = *C.pseudoarquatus* A.H.Smith (1944)
(= *C. riederi* Weinm. ss. Melot 1986 ?)

There are a large number of records of *Cortinarius fulvoochrascens* from different parts of Europe. Observations on numerous collections from Wyoming and Washington indicated that this taxon might be conspecific with *Cortinarius pseudoarquatus* A.H.Smith. A study of the holotype as well as additional collections preserved in the herbaria in Ann Arbor and Seattle confirmed this supposition.

Cortinarius fulvoochrascens is widely reported in Europe from mountainous conifer forests, mainly under spruce. It shows some degree of variability and Henry (1889) has described a series of varieties and closely related species. The variability concerns macroscopic characters and spore size. However, the shape of the spores is rather constant. From our observations the correlation between variability of spore size and macroscopic characters is rather inconstant and therefor it is difficult to distinguish species or varieties in this complex on that bases. We made the same observation in North America. Table 1 gives an idea of the variability of spore size both in Europe and America.

The taxon is very common in the Rocky and Cascade Mountains. We have seen it in Wyoming, Washington and California. A.H.Smith had many records from Oregon (under the name *C. pseudoarquatus*). Typical forms agree well with European collections, however, the range of variability seems to be even greater in North America than in Europe. We have studied numerous collections of A.H.Smith, D.E.Stuntz and our own collections and thus far have been able to recognize two varieties, var. *fulvoochrascens* and var. *subcaninicolor* and one form, f. *marginatus* under var. *fulvoochrascens*. Further study may determine that there are additional varieties or forms.

Cortinarius fulvoochrascens Henry (1943) var. *fulvoochrascens*

The following collections of our own correspond to the type variety. **Wyoming:** 87/218a (IB, BRY), origin of Flagstaff Creek, Teton National Forest, 12-08-1987; 87/258 (IB, BRY), above Brooks Lake, Shoshone National Forest, 19-08-1987; 87/345 (IB, BRY), 5 miles north of Union Pass, Shoshone National Forest, 31-08-1987; **Washington:** 89/384, (IB) Stevens Pass, King Co., Washington, (*Abies lasiocarpa*), 01-09-1989.

Table 1. Measurements of basidiospores in μm (n=31). Collections from North America and Europe (A= Austria, F= France, I=Italy, N= Norway, S=Sweden)

North America

Collection number	mean (n=31)	minimum	maximum	Q	V
AHS 4820 Washington	1.5 x 8.8	14.8 x 8.2	18.2 x 10	1.7	613
IB 87/258 Wyoming	14.7 x 7.5	13.2 x 6.5	17.1 x 8.2	1.9	440
AHS 19192 Oregon	14.5 x 8.5	13.5 x 7.6	16.2 x 9.4	1.7	548
AHS 48444 Washington	14.4 x 8.6	12.9 x 7.6	15.8 x 10	1.7	563
AHS 289429 Oregon	14.4 x 8.5	12.9 x 7.6	15.9 x 8.8	1.7	545
AHS 16569 Washington	14.6 x 8.3	13.5 x 7.9	15.6 x 8.8	1.8	522
AHS 26627 Oregon	14.2 x 8.4	12.9 x 7.6	15.9 x 9.1	1.7	515
IB 89/384 Wyoming	14.1 x 8.2	12.9 x 7.4	14.7 x 8.8	1.7	497

AHS 31303 Washington	14.0 x 8.3	12.9 x 7.9	14.7 x 8.7	1.7	507
AHS 1740* Oregon	13.9 x 7.7	12.7 x 7.0	14.7 x 8.7	1.8	430
AHS 83034 Idaho	13.8 x 8.5	12.7 x 7.9	15.3 x 9.4	1.6	529
AHS 82458 Idaho	13.8 x 8.1	12.4 x 7.4	14.7 x 8.8	1.7	471
AHS 40609 Washington	13.8 x 7.4	12.4 x 6.8	15.0 x 8.8	1.85	403
IB 87/276 Wyoming	13.7 x 8.1	12.6 x 7.1	15.3 x 8.8	1.7	472
Stuntz 4276 Washington	13.7 x 7.8	12.0 x 7.0	15.3 x 8.3	1.75	436
JFA 9556 Washington	13.4 x 7.1	11.7 x 6.7	16.7 x 8.0	1.9	354
IB 87/345 Wyoming	13.3 x 7.5	11.8 x 7.1	14.7 x 8.2	1.8	395
Stuntz 4205 Washington	13.3 x 7.7	12.7 x 7.0	14.7 x 8.3	1.7	412
IB 87/344 Wyoming	13.2 x 7.9	12.4 x 7.1	14.1 x 8.8	1.7	431
AHS 1140 Idaho	13.1 x 7.5	12.4 x 7.1	14.1 x 7.9	1.8	414
JFA 9568 Washington	13.0 x 7.3	11.7 x 6.5	16.0 x 8.0	1.8	367
IB 91/371 Wyoming	12.7 x 7.4	11.2 x 6.5	13.2 x 8.2	1.7	366
Stuntz 3332 Washington	12.7 x 7.1	11.0 x 6.7	14.0 x 8.0	1.8	338
IB 87/218 Wyoming	12.5 x 7.6	11.3 x 6.7	14.0 x 8.3	1.7	382
IB 87/266 Wyoming	12.2 x 7.4	11.3 x 7.0	13.0 x 8.0	1.7	348
IB 91/710 California	12.1 x 7.7	11.5 x 7.5	13.4 x 8.5	1.6	-
Stuntz 4233 Washington	11.5 x 6.6	10.3 x 5.7	13.3 x 7.3	1.75	263

AHS 30669 Washington	10.5 x 6.7	9.7 x 6.2	11.8 x 7.1	1.5	246
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Europe

IB19-09-69 A	14.5 x 7.5	12.4 x 6.7	15.6 x 8.2	1.9	422
IB 74/160/ S	14.3 x 8. 2	12.9 x 7.6	15.3 x 9.4	1.7	512
IB 68/53 A	13.4 x 7.7	12.4 x 7.1	14.7 x 8.8	1.7	415
IB 77/235 N	13.3 x 8.4	11.8 x 7.7	14.4 x 9.4	1.6	498
IB 68/53 ?	13.3 x 7.7	11.8 x 7.6	14.7 x 8.2	1.7	412
IB 71/202 F	13.3 x 7.4	11.2 x 6.8	17.1 x 8.5	1.8	386
IB 70/25 S	12.9 x 7.5	10.6 x 7.1	13.8 x 7.9	1.7	379
IB 48/325 A	12.8 x 7.4	11.8 x 7.1	13.8 x 8.2	1.7	371
IB 57/98 ?	12.7 x 7.5	12.0 x 6.7	14.7 x 8.0	1.7	375
IB 92/51 A	12.6 x 7.4	11.2 x 7.1	14.1 x 7.9	1.7	362
IB 88/240 I	12.5 x 7.5	11.2 x 7.1	13.5 x 8.2	1.7	369
IB 79/360 S	12.4 x 7.3	10.6 x 6.8	14.1 x 7.9	1.7	349
IB 80/340 S	12.3 x 7.5	11.2 x 7.1	12.9 x 7.7	1.6	356
IB 78/381 A	12.1 x 7.2	11.1 x 6.5	13.2 x 7.7	1.7	333
IB 93/58 A	11.9 x 7.2	11.5 x 7.0	12.3 x 7.7	1.65	-
IB 77/238 N	11.8 x 7.4	10.6 x 7.1	12.9 x 8.2	1.6	333
IB 82/454 I	11.8 x 7.2	10.6 x 6.8	12.9 x 7.6	1.64	325

Cortinarius fulvoochrascens R.Hry. var. *subcaninicolor* R. Hry.? (1989)
(Fig. 32)

Pileus 4-10 cm wide, semiglobose to convex, margin remaining inrolled for a relatively long time, only slightly viscid, nearly mat, colors from grayish-brown (Caill 71M or somewhat darker) with darker brown areas and spots to ochraceous brown (Mu 10YR 7/6) mixed or marbled with very fine brown spots or streaks, or yellow-brown (Caill 65M, 59M), margin sometimes slightly innately fibrillose in older specimens, old specimens also with dark brown spots in the center or interspersed with gray spots.

Lamellae grayish blue, rather dark when young (Met 19C3), then paler, 19C2, turning more gray (19C1), becoming mixed with brown, finally milk-coffee-brown, near Mu 10YR 5/6, Caill 60P, edges strongly serrulate, emarginate or arcuate at the stipe.

Stipe 5.5-8 cm long, 17-25 mm at the apex, base 20-35 mm thick, subequal to clavate or slightly bulbous, bluish when young, becoming darker blue and brown where bruised, pale bluish, finally whitish in the upper part, lower part turning

brown, sometimes with indistinct belts from veil remnants. Cortina whitish or pale bluish when young.

C o n t e x t bluish in young buttons, turning whitish in pileus, yellowish in the base of the stipe, remaining pale bluish in the apex for a long time.

C h e m i c a l r e a c t i o n s: KOH dark brown on the pileipellis, only pale grayish (brown) in the context. Under UV purplish in all parts.

M i c r o s c o p i c c h a r a c t e r s: Basidiospores 11-14 x 6.7-8.3 μm , ellipsoid to slightly subamygdaliform, mean 12.5 (S = 0.8) x 7.6 μm (S = 0.4), Q = 1.65, V = 255-496, mean 380 S = 60)

H a b i t a t: under *Picea engelmannii* in mossy forest meadow.

Collection examined: **Wyoming**: IB 87/218 Flagstaff Creek near origin, Teton National Forest, 12-08-1987.

C o m m e n t s: When collecting this fungus we mistook it in the field for large forms of *C. caninus* Fr. Microscopic examination revealed the affinity with the *fulvoochrascens*-complex. In the field notes we called it "var. *caninoides*". Two years later R. Henry (1989) described var. *subcaninicolor* which very likely is this taxon. The structure of the pileipellis is typical for a *Phlegmacium*, the surface with a loose cover of thin hyaline, gelatinized hyphae 3-4.5 μm in diameter, epicutis hyphae 6-9 μm , and a thin, indistinct subcellular hypodermium.

Cortinarius fulvoochrascens Hry. f. *marginatus* Moser & McKnight, nov. f. (Fig.10)

Differt a typo bulbo marginato et habitu plerumque robustiore.

Holotypus IB 87/344, prope Union Pass, Shoshone National Forest, Fremont Co., Wyoming, 31.VIII.1987, in herb. IB, isotypus in BRY conservatur.

P i l e u s up to 9 cm, convex, margin at first inrolled, viscid, with gray-brown colors, with brown streaks and spots, margin somewhat bluish lilac, Plumbago Blue (R), soon gray and later mixed with brown.

L a m e l l a e deep blue, Dark Grayish Lavender to Ramier Blue (R), becoming more dingy with maturity, Purple Drab, Brownish Drab (R), edges eroded, emarginate, close, L=85-90, l=3, 13-14/cm at the margin, up to 8 mm broad (= half the thickness of the context).

S t i p e up to 7 cm long, 20-27 mm above, the obtusely marginate somewhat napiform bulb 50 mm across, bluish, Lavender Gray (R), the margin of the bulb discolored brownish, bulb underneath white. Veil whitish ?.

C o n t e x t blue in all parts, Lavender Gray (R) or paler, in the upper part of the stipe darker, Endive Blue (R). Odor not distinctive, taste mild.

M i c r o s c o p i c c h a r a c t e r s: Basidiospores: coll. IB 87/344 (holotype): 12.3-14.1 x 7-8.8, mean 13.2 (S = 51) x 7.9 (S = 0.37), Q = 1.7, V = 322-575, mean = 431 (S = 53.9); coll. IB 91/344: 11.1-13.2 x 6.4-8.3, mean 12.7 (S = 0.5) x 7.4 (S = 0.4), Q = 1.7, V = 245-459, mean 366 (S = 47.7)

H a b i t a t: Conifer forests, particularly under spruce (*Picea engelmannii*).

Collections examined: **Wyoming**: 87/344 (IB, holotype) 5 miles north of Union Pass. Shoshone National Forest, Fremont Co., 31-08-1987; 91/371 (IB), Union Pass, Windriver Mountains, Shoshone National Forest, 30-08-1991. **Idaho**: R. Shaffer 1140, leg. A.H.Smith & R. Shaffer, Big Payette Lake, Valley Co., 15-09-1956. **California**: 91/710 (IB), Bullards Bar Recreation Area, Schoolhouse Camp Ground,

Yuba Co, under *Pseudotsuga* and *Pinus*, 9-12-1991 .

C o m m e n t s : Collection 87/266, near Brooks Lake Lodge, Shoshone National Forest, Wyoming, 19-08-1987, may eventually also belong to this taxon, but the colors of the pileus are more bluish at first, the color of the stipe and context deeper blue.

Section *Coerulescentes* Hry. ex Brandr. & Melot

Cortinarius (Phlegmacium) aureopulverulentus Mos. (1952)

(Fig. 15, 34)

Misidentification: *Cortinarius herpeticus* Fr. ss. Cke. (pl. 849) non Fr.

P i l e u s 4-7 cm broad, hemispheric at first, then convex, often somewhat undulate, margin in young specimens involute, glutinous to viscid, with rather mixed colors, more or less strongly innately fibrillose, in young fruitbodies the center dark reddish brown, Caill 37S to 35S, margin yellowish from the veil, Caill 77L to 79L, sometimes this color persists in age, older fruitbodies more grayish brown, Caill 53N, 29N, center 55N, occasionally with orange-brown patches near the margin, Caill 57L, sometimes the center very dark grayish brown or porphyraceous brown, Caill 53P.

L a m e l l a e at first blue, violaceous, Met 17B2, 18B2, becoming rusty brown with age, Mu 10YR between 6/6 and 5/6, crowded, L=90-100, l=1-3, edges eroded, emarginate-adnate, about 10 mm broad(=1.5 x thickness of pileus context), trama retaining the bluish color for a long time.

S t i p e 4-6 cm long, 15-20 mm thick, marginate bulb 15-35 mm, apex at first bluish, downwards and margin of the bulb yellow from universal veil, bulb underneath pale yellowish or whitish.

C o n t e x t at first bluish in pileus and apex of stipe, later becoming dingy whitish, except in stipe where at least the marginal areas remain yellow. Odor weak, somewhat of freshly baked goods. Taste mild.

C h e m i c a l r e a c t i o n s : KOH on all parts ink-red where covered by the yellow veil, center of pileus dark brown. Under UV pileus red, stipe violet, yellow in parts covered by the veil.

M i c r o s c o p i c c h a r a c t e r s : Basidiospores 11.3-13(-13.8) x 6.7-8.7 μ m, mean 12 (S = 0.48) x 7.5 μ m (S = 0.29), Q = 1.6, V = 290-511, mean 361 (S = 51.7). Basidia 38-42 x 10 μ m, 4-spored, clavate, with basal clamp connections. Hyphae of the yellow universal veil in KOH with red, but dissolving pigment, 2.5-4.5 μ m wide, with clamp connections.

H a b i t a t : Under *Picea engelmannii*.

Collection examined. **Wyoming:** 87/197 (IB, BRY), Flagstaff Road, about 1.5 miles from the eastern end, Teton National Forest, 10-08-1987.

C o m m e n t s : The color of the lamellae, stipe and veil as well as the ink-red KOH reaction and spore size and shape agree fully with *C. aureopulverulentus* Mos. from Europe. The pileus color is somewhat more brownish. Pileus colors are rather variable in European collections, but generally brighter, sometimes even with slight bluish tinges.

Section *Scauri* Fr.

Cortinarius (Phlegmacium) aureofulvus Mos. (1952)
(Fig.16, 33)

Pileus 3-6 cm across, hemispherical at first with inrolled margin, then convex, later also plano-convex to subumbonate or umbonate, surface glutinous, the disc sometimes with spots from the dried gluten, center orange-brown, fulvous to reddish brown, Chestnut Brown to Kaiser Brown or tinted with Zinc Orange to Ochraceous Tawny (R), towards margin bright chrome yellow, Lemon Chrome, Strontian Yellow (R), towards disc a little duller, about Mustard Yellow (R), not innately fibrillose.

Lamellae greenish yellow, between Citron Green and Lime Green or Chartreuse Yellow (R) or a little more gray, becoming olive brown to rusty brown in age from the spores, emarginate, edges eroded, close to crowded, L= about 100, l=1, 20/cm at the margin, 3-5.5 mm wide (equaling thickness of pileus context).

Stipe 3-6 cm long, apex 7-12 mm thick, the marginate bulb 10-21 mm, surface pale greenish yellow to pale bluish green, Light Viridine Green, Pale Cendre Green, Seafoam Yellow (R), lower part and margin of the bulb covered by yellow fibrils from the veil [Chartreuse Yellow to slightly Martius Yellow (R)], the rim of the bulb later discoloring to orange-brown or orange red-brown, sometimes near Apricot Orange (R), basal mycelium whitish or yellowish with brown discoloration.

Context 6-11 mm thick under the disc, gradually thinner toward the edge, solid and firm, whitish, in the stipe with a slight bluish cast at least when quite fresh, slightly greenish yellow underneath the cuticle and in the cortex of the stipe. Odor not distinctive, fungoid to slightly fragrant, taste mild.

Chemical characters: KOH on the cuticle dark reddish, purplish brown to vinaceous brown, on the lamellae brown with a slight purplish tinge, without reaction in the context.

Microscopic characters: Basidiospores 8.7-10.3(-11.3) x 5-6.3, means 9.4 (S = 0.4) x 5.7 μ m (S = 0.3), Q = 1.7, V = 122-196, mean = 159.1 (S = 20.3). Basidia 32-35 x 10 μ m, 4-spored.

Habitat: Subalpine conifer forests under *Picea engelmannii*, *P. pungens*, *Abies lasiocarpa*, *Pseudotsuga menziesii*.

Collections examined: Wyoming: 87/221 (BR, BRY), above Turpin Meadow close to the creek, Teton National Forest, 13-08-1987. **Washington:** 89/428, 89/474, (IB), JFA 10065, Trailhead to Easy Pass, Skagit Co., 06-09-1989 and 12-09-1989. A.H.Smith 16997 (under the name *C.cedretorum* R.Mre.) Lake Angeles Trail, Olympics, 19-10-1941.

Comments: The macro- and microscopic as well as the macro-chemical characters of the American collections agree fully with European material. In Europe the species is associated with *Picea abies* and occurs particularly in mountainous to subalpine forests on at least slightly calcareous soil.

Section *Fulvi* Mos. & Horak (1975)

Cortinarius (Phlegmacium) elegantior Fr. var. *americanus* Mos. & McKnight, var. nov.
(Fig. 17, 36)

Differt a typo coloribus vivide flavo-brunneis, aurantio-brunneis, velo flavo et sporis nonnihil minoribus, 11.5-13.8 x 7.7-9.2 μ m, limoniformibus, fortiter verrucosis.

Holotypus 89/59, above Turpin Meadow Lodge, Teton National Forest, 17. VII.1989 in herb. IB, isotypus in BRY conservatur.

Pileus 5-12 cm across, hemispheric at first, then strongly convex with inrolled margin, later applanate, sometimes undulate, very glutinous when wet, relatively pale yellow in young stages due to the yellow veil, Mu 5Y8/6, center more yellow ocher, Mu 3.5Y8/6, disc finally with brownish tints, in age the brown colors more dominating over entire surface but sometimes in more or less irregular patches, Caill 65L, 57L, to 57M, but lacking veil remnants in mature pilei which are typical for var. *elegantior*.

Lamellae pale yellow with slight olivaceous hue, brown in age, Caill 60P or somewhat paler, often with rusty-brown spots, more or less emarginate, edges eroded, crowded, L about 120, l=(1-)3(-5), 6-11 mm broad.

Stipe 4-7 cm long, 18-30 mm thick, the marginate bulb 25-40 mm wide, at first pale yellowish, Mu 5Y8/3, later becoming brass yellow, some parts also turning brown, the margin of the bulb fringed by sulfur yellow veil.

Context pale yellowish, Mu 5Y8/3 or somewhat paler, becoming brown where eaten by larvae, becoming darker in base of stipe, often almost orange yellow with age but never rhubarb colored as in var. *elegantior*. Without distinctive odor, taste mild.

Sporeprint dark rust brown, nearly Russet (R), Moser B8.

Chemical reactions: vapor of NH_4OH gives a pink discoloration in the bulb. In 3% KOH the spore content and the gill trama stained more or less red in several collections. Under UV the context pink in pileus and bulb, yellowish in stipe, veil and margin of pileus violaceous pink.

Microscopic characters: Basidiospores (10)-12.3-14.3(-15.3) x 7-9.3 μ m, mean 12.9 (S=0.78) x 8.2 μ m (S = 0.35), Q = 1.7, V = 347-642, mean = 442 (S = 72.8), almond- to lemon-shaped, strongly verrucose. Basidia 42-45 x 9-9.5 μ m, 4(-2)-spored, with basal clamp connections. Edges of lamellae occasionally with irregular, clavate to subcapitate cheilocystidia, 35-50 x 6-12 μ m, some with yellow content. Hyphae of the gelatinous layer of the pileus 2-4 μ m wide, radially arranged, hyaline, with clamp connections, hyphae of the epicutis 6-9 μ m wide, walls yellowish in KOH, not encrusted. Hyphae of the cortina 4-5 μ m wide, with clamp connections.

Habitat: Under *Picea engelmannii* and *P. pungens* in subalpine forests.

Collections examined: **Wyoming**: 83/163 (IB,BRY, KHM 83073001) near road on west side of Mount Washburn, Yellowstone National Park, leg. K.H.McKnight, 30-07-1983; 87/57, (IB, BRY) above Turpin Meadow, Teton National Forest, 23-07-1987; 87/193 (IB, BRY), Flagstaff Road, Teton National Forest, 09-08-1987; 89/59 (holotype IB, isotype BRY), above Turpin Meadow Lodge, Teton National Forest, 17-07-1989; 89/65 (IB, BRY), Snake River Picknick area SE of Signal Mountain, 18-07-1989; 89/189 (IB, BRY) Fourmile Meadow, Creek behind beaver pond, Teton National Forest, 07-08-1989; 89/198 (IB) near Togwotee Lodge, Teton National Forest, 09-08-1989; 89/226 and 89/226b, (IB, BRY) about 1 mile from eastern end of Flagstaff Road, Teton National Forest, 12-08-1989; 89/263 (IB), trail to Turbid Lake, Yellowstone National Park, 16 Aug. 1989; 91/140 (IB, BRY), above Turpin Meadow Lodge, under *Picea pungens* and *P. engelmannii*, Teton National Forest, 29-07-1991; 91/141 (IB, BRY), same area and date, about 1/2 mile from 91/140; 91/207 (IB,

BRY) 2.5 miles below Togwotee Pass, Teton National Forest, 09-08-1991 ; 91/273 (IB, BRY), Union Pass, Lake of the Woods, Teton National Forest, 15-08-1991.

Table 2. Comparison of basidiospore measurements of different collections of *C. elegantior*.

Collection number	Origin	measures (n=31)
Europe		
IB 77/100	Switzerland	13.0-15.1 x 7.7-8.5
IB 79/599	Austria/Tyrol	13.0-15.2 x 7.7-8.5
IB 80/222	France (Courchevelle)	12.8-15.0 x 7.3-8.3
IB 77/272	Norway (Lunner)	13.0-15.0 x 7.7-8.5
North America		
IB 83/163	Wyoming	10.0-13.0 x 7.0-7.7
IB 87/57	Wyoming	12.3-14.3 x 7.7-9.2
IB 89/59	Wyoming	11.5-13.8 x 7.0-9.2
IB 87/189	Wyoming	11.5-14.2 x 7.7-8.5
IB 87/193	Wyoming	11.5-13.0 x 7.0-8.5
IB 89/65	Wyoming	11.3-14.3 x 7.7-9.0
IB 89/189	Wyoming	12.3-15.7 x 7.0-9.3
IB 89/226	Wyoming	12.3-15.4 x 7.2-9.2
IB 89/226b	Wyoming	11.5-15.0 x 7.0-8.5

C o m m e n t s: This taxon is very similar to *C. elegantior* var. *elegantior* in habit, spore characters and in the reaction with NH_4OH . Variety *americanus* differs in yellow veil color, in paler more yellow pileus color lacking olivaceous tinges, and the colors of the context which are yellowish but never deep rhubarb color in the lower part of the stipe. This rhubar color is distinctive and characteristic of var. *elegantior* from Europe. Also the initially white and later ochraceous to brownish spots caused by veil remnants typical for var. *elegantior* have never been observed in var. *americanus*. The spores in most American collections are smaller than in European material. The differences, however, are not great enough to warrant a specific separation. In several collections the spore content and/or the gill trama stains red in 3% KOH. However, this seems to be rather a quantitative character as some collections show a strong reaction, others only weakly, and in some it is not at all recognizable. We can not correlate this with any other character and we have made the same observation in European material.

The interpretation of *C. elegantior* in Europe remains somewhat unsettled. Henry (1935, 1943) originally thought that the species he called *C. elegantissimus* Hry. (validated 1989) might be the species of Fries (1838). Recently he seems to have

returned to his first opinion. This interpretation, however, does not agree with the protologue. Fries (1838) indicates the habitat for his species as "silvis montanis", and later in the Monographia (1863) "in silvis montanis abiegnis". *C.elegantissimus* Hry. to the contrary, is strictly a hardwood species. Moser admits that our interpretation also has some weak points, particularly with regard to the color of the lamellae which Fries calls "vitellinis olivascentibus".

There is no collection of A.H.Smith under the name *Cortinarius elegantior* in the herbarium at Ann Arbor. A collection of C. H. Kauffman from Leal, Colorado, 18 Aug. 1919, which has limoniform spores $13.5-15.5 \times 8-10 \mu\text{m}$ may represent var. *americanus*. Also at Ann Arbor is a collection of K.H. McKnight, F8233, (=65090817) MICH and BRY, from Pebble Creek, Yellowstone National Park, Wyoming 9 Aug. 1965, which has spores $13-14 \times 8-9 \mu\text{m}$ and shows the characteristic dark spore print. This is very likely this taxon. There may be collections of A.H.Smith of this taxon among his numerous unnamed collections. In the manuscript which he left he gives a description of *C. elegantior* but without reference to any collection.

Cortinarius (Phlegmacium) flavaurora Moser. & McKnight, spec. nov.
(Fig. 18, 37)

Praemagna species pileo 5.5-14.5 cm lato, convexo, margine involuto, dein plano-convexo, glutinoso, disco pallide rufo-brunneo, ochraceo-brunneo, marginem versus pallide flavo, aetate interdum totius flavo-brunneo, saepe disco oblecto e velo albedo, lamellis argillaceis vel leviter flavo-olivaceis, dein pallide griseo-brunneis vel fuscis, adnatis emarginatis, valde confertis, 6-10 mm latis, stipite 4.5-10 cm longo, 20-30 mm crasso, bulbo marginato 30-50 mm lato, albidulo usque pallide allutaceo, cortina copiosa praedita, carne albidula, in bulbo flava vel brunneola, sapore miti, odore subnullo.

Sporis $10-12 \times 6-7.3 \mu\text{m}$, amygdaliformibus usque limoniformibus, valde verrucosis, basidiis $42-45 \times 9-9.5 \mu\text{m}$, tetrasporigeris, fibulis praesentibus.

Habitatio in piceetis subalpinis (*Picea engelmannii*), holotypus 89/187, prope Fourmile Meadow, Teton National Forest, Wyoming, 7.VIII.1989, in herb. IB conservatur.

Pileus 5.5-14.5 cm across, convex with inrolled margin, sometimes the center depressed, later plano-convex, glutinous, with characteristic colors, the margin very pale yellow, Caill 80K to almost 85K, towards the center pale reddish brown, ochraceous brown, Caill 57L, later also yellow over the entire surface, Caill 65N to 60N, sometimes paler, sometimes slightly innately fibrillose, center often with white patches of veil remnants, margin often appendiculate from the cortina.

Lamellae argillaceous or with a slight olive-yellowish tint (wax yellow), Caill 77L, close to Clay Color (R), later pale gray brown, adnate to emarginate, edge uneven to eroded, very crowded, $L=100-140$, $l=3(-5)$, 17-30/cm at the margin, 6-10 mm broad (equals thickness of pileus context).

Stipe 4.5-10 cm long, 20-30 mm thick, the obliquely marginate bulb 30-50 mm across, whitish to pallid, covered by rich whitish cortina when young, bulb white underneath.

Context whitish, slightly yellowish or brownish in the bulb. Odor not distinctive, taste mild.

Chemical reactions: KOH chrome yellow on all yellow parts of

the pileus surface, dark brown on the brownish parts, without reaction in the context. NH_4OH no reaction in the context or in the base of the stipe. Under UV pileus surface yellow with red areas, stipe and context purplish violet.

Microscopic characters: Basidiospores $10-12 (-14.6) \times 6-7.3 \mu\text{m}$, means $11 (S = 0.39) \times 6.7 \mu\text{m} (S = 0.21)$, $Q = 1.6$, $V = 194-326$, mean $210 (S = 23)$. Basidia $35-45 \times 9.0-10.7 \mu\text{m}$, 4-spored, clavate, with basal clamp connection, sterigmata $3-4 \mu\text{m}$. Gelatinous layer on pileus surface $250-350 \mu\text{m}$ thick, hyphae $3.5-5(-7) \mu\text{m}$ wide, with clamp connections, subradially to somewhat irregularly arranged, in the upper layer somewhat ascending, repent on surface, some amorphous yellow pigment masses within mucous substance. Epicuticular hyphae radially arranged, $6-10 (-11) \mu\text{m}$ thick, walls slightly yellowish to yellow brownish. No cheilo- or pleurocystidia present. Lamellar trama regular, hyphae $7-9 \mu\text{m}$ wide, hyaline.

Habitat: under *Picea engelmannii* in subalpine forest.

Collections examined. **Wyoming:** 89/187 (holotype IB, isotype BRY), Fourmile Meadows, Teton National Forest, 07-08-1989; 89/210 (IB, BRY and JFA 9913) same area, 11-08-1989; 91/339 (IB), same area, 26-08-1991; 89/316 (IB) southwest of Brooks Lake Lodge, Shoshone National Forest, 23 Aug 1989.

Comment: Macroscopically *Cortinarius flavaurora* resembles somewhat certain taxa of the *elegantior* group. However, it lacks the typical reaction with NH_4OH in the bulb, the colors are much paler and the spores are significantly smaller. It also lacks the dark rust-brown sporeprint of *C. elegantior*.

Subgenus *Telamonia* (Fr.) Trog (1844)

Section *Telamonia*

Cortinarius (Telamonia) resinaceus Moser. & McKnight, spec. nov.
(Fig. 19, 38)

Pileo 1.8-7 cm lato, convexo, obtuse conico vel campanulato, aetate applanato, subhygrophano, pallide rufo-ochraceo, marginem versus griseo tincto, sicco ochraceo-brunneo, lamellis pallide fuscis, confertis, emarginatis usque late adnatis, stipite 3.5-7 cm longo, 7-20 mm crasso, aequali, clavato vel fusoides-ventricosus, supra albidulo vel pallide argillaceo, infra albido, plus minusve fibrilloso, interdum velo peronato albido praedito, duro. Carne pallide argillacea, pallide brunnea. Odore forte resinaceo (resinae coniferarum similis), sapore miti.

Sporis $6.7-8.7 \times 3.3-4.3 \mu\text{m}$, ellipsoideis, subglabris, punctatis, basidiis $35-38 \times 6.5-7.5 \mu\text{m}$, tetrasporigeris, cystidiis nullis.

Habitatio in silvis coniferis subalpinis (*Picea engelmannii*, *Pinus contorta*, *Pinus albicaulis*), holotypus 83/390, supra jugum Dunraven in 2900 m altitudine, Yellowstone National Park, Wyoming, USA, 27. VIII.1983, in herb. IB, isotypus in BRY conservatur.

Pileus 1.8-7 cm wide, convex to obtusely conic or campanulate, applanate with age, margin often undulate, only slightly hygrophanous, not translucently striate, with relatively pale colors, in moist condition reddish-ocher, Expo 59M to 57M, margin mixed with grayish tints, near Expo 67N, in dry condition yellow-brown, Expo 60M, margin somewhat covered by white fibrills from the veil.

L a m e l l a e milk coffee brown, Tawny (R), approximately Mu 10YR 5/6 to 5/8, edges slightly floccose to eroded, crowded, L= 80, l=3-7, 20/cm at the margin, 3-8 mm wide (=4-5 x pileus context), emarginate to almost broadly adnate.

S t i p e 3.5-7 cm long, 7-20 mm thick, equal to clavate or fusoid-ventricose, upper part whitish to pale argillaceous, Expo 71K, slightly fibrillose to finely squamulose, lower part white, sometimes with a recognizable peronate veil, hard and compact.

C o n t e x t pale argillaceous (Expo 71K) to pale brownish (slightly paler than Expo 70M), in the cortex darker brownish variegate. Odor very striking of conifer resin, taste mild.

C h e m i c a l r e a c t i o n s: KOH gives almost no reaction on either pileipellis or context (only slightly brownish). Under UV pileus red, stipe purple, veil bluish.

M i c r o s c o p i c c h a r a c t e r s: Basidiospores $6.7-8.7 \times 3.3-4.3 \mu\text{m}$, mean 7.5 ($S = 0.41$) $\times 3.9 \mu\text{m}$ ($S = 0.26$), $Q = 1.6-2.2$, mean 1.9 ($S = 0.13$), $V = 41-85$, mean 60 ($S = 9.7$), ellipsoid, nearly smooth to slightly punctate, the apex with slightly stronger ornamentation. Basidia $35-38 \times 6.5-7.5 \mu\text{m}$, 4-spored (occasionally 1- or 2 spored), clavate. Hyphae of the lamellar trama $5.5-6.5(-7) \mu\text{m}$ thick, hyphae of the cortina $3-5 \mu\text{m}$, rather large clamp connections present. Epicutis hyphae $4-7 \mu\text{m}$, walls pale brown to yellow-brown, slightly encrusted, hypodermium subcellular, elements $15-25(-28) \mu\text{m}$ thick, segments $20-45 \mu\text{m}$ long, pileus trama of radial hyphae, $8-15 \mu\text{m}$ thick, pseudoparenchymatic in deeper layers.

H a b i t a t: In subalpine conifer forests under *Picea engelmannii*, *Pinus contorta* and *P. albicaulis*.

Collections examined: **Wyoming**: 83/390 (holotype IB, isotype BRY), above Dunraven pass, 2900 m, Yellowstone National Park, Wyoming, 27-08-1983; 83/264 (IB), Brooks Lake, Shoshone National Forest, 15-08-1983; 83/279 (IB), east side of Lewis Lake, Yellowstone National Park, 17-08-1983; 87/265 (IB, BRY), south of Brooks Lake Lodge, Shoshone National Forest, 19-08-1987; 91/267 (IB, BRY), Lake of the Woods, Windriver Mountains, Teton National Forest, 15-08-1991.

C o m m e n t s: In Europe there is a species similar to *C. resinaceus* but without the characteristic odor of conifer resin and with distinctly different spores.

Cortinarius (Telamonia) umbilicatus Karst. (1893)
(Fig. 20, 21, 35)

Syn. *Cortinarius adalberti* Favre ex Mos. = *C. pateriformis* Fr. ss. Ricken = *C. depressus* Fr. ss. Brandrud et al.(1992)

P i l e u s 2.4-5.5 cm broad, obtusely conic to plano-convex, hygrophanous, not translucent-striate when moist, dark chestnut brown, Caill 47S to 49S, 47R, margin with white veil remnants, fading to yellow-brown, Caill 57N, toward the center somewhat reddish brown, Caill 57P.

L a m e l l a e relatively bright yellow brown, Caill 60N to 57N, later with darker spots (57P), shallowly and indistinctly emarginate, edges entire to slightly eroded, close, L=60-70, l=3-7, about 15/cm at the margin, 3-6(-7) mm broad.

S t i p e rigid, 3-5.5 cm long, 5-10 mm thick, more or less equal to somewhat flexuose, apex pallid, downwards increasingly brown to umber brown hues beneath

the patches of white veil which form more or less distinct belts.

C o n t e x t dark brown when moist, when dry pallid in the pileus, in the base of the stipe umber brown. Without significant odor, taste mild.

M i c r o s c o p i c c h a r a c t e r s: Basidiospores $6.7\text{--}8.7 \times 3\text{--}4.7 \mu\text{m}$, mean 7.7 ($S = 0.44$) $\times 4 \mu\text{m}$ ($S = 0.35$), $Q = 1.9$, $V = 32\text{--}99$, mean 66 ($S = 15$), ellipsoid to subfusoid, punctate.

H a b i t a t: Under *Pinus contorta* and *Picea engelmannii* and other conifers.

C o l l e c t i o n s e x a m i n e d: **Wyoming**: 87/96 (IB, BRY) Falls Campground, east of Togwotee Pass, Shoshone National Forest, 27-07-1987; 83/295 (IB), Elk Creek, Yellowstone National Park, 18-08-1983; 87/193 (IB), 87/193b (IB, BRY and JFA 9476), Flagstaff Road, Teton National Forest, 09-08-1987; 87/282 (IB) and 87/282a (IB, BRY), Union Pass, Lake of the Woods, Teton National Forest, 21-08-1987, leg. K.McKnight; 91/238 (IB, BRY), Union Pass, Lake of the Woods, Teton National Forest, 13-08-1991; 91/251 (IB) same area and date; 91/246 (IB) Union Pass near trailhead to Union Peak, Shoshone National Forest 13-08-1991. **Washington**: 89/378 (IB and JFA 10011), Stevens Pass Ski Area, King Co., 01-09-1989; 89/429 (IB), trailhead to Easy Pass, Skagit Co., 06-09-1989. **California**: 91/598 (IB), Sand dunes on Samoa peninsula near Eureka, Humboldt Co., under *Pinus murrayi*, 29-11-1991.

C o m m e n t s. *Cortinarius umbilicatus* is a rather common fungus both in Europe and in North America. In the University of Michigan Herbarium are two collections by Kauffman from Colorado (Leal) under the unpublished name "*Cortinarius nigrelloides*". Moser collected it also in a spruce plantation in Michigan, 91/482 and 91/482a (IB), Stinchfield Wood, Washtenaw Co, Michigan, 29 Oct 1991. In part 3 of this series Moser (1993) described an alpine form associated with *Salix arctica* (IB 91/348). Brandrud et al. (1992) call *Cortinarius umbilicatus* (= *C. adalberti*) *Cortinarius depressus* Fr. We object to this interpretation. Fries (1863) placed his fungus in the subgenus *Hydrocybe* and describes and figures it without the white veil, which is always strongly developed in *C. umbilicatus* P.Karst. The currently used name *C. adalberti* Favre ex Mos. is, however, superseded by the older name of Karsten. A revision of the holotype of *Cortinarius umbilicatus* Karst. revealed that this species is conspecific with *C. adalberti*. Melot (in lit.) thinks that also *C. nitens* P. Karst. might be the same species. However, apparently no type material exists species, therefor the best choice is certainly *C. umbilicatus* P. Karst, (holotype leg. P.Karsten, Mustiala Salois, 29.8.1892). We give some data of the revision of the type collection: The dried specimens show a relatively short stipe and a relatively pale color of the lamellae. The basidiospores are $5.7\text{--}7.2 \times 3.5\text{--}4.2 \mu\text{m}$, mean 6.3 ($S = 0.33$) $\times 3.8 \mu\text{m}$ ($S = 0.18$), $Q = 1.52\text{--}1.83$, mean 1.65 ($S = 0.07$), $V = 35.4\text{--}61.8$, mean 47.5 ($S = 6.45$), ellipsoid, slightly verrucose to nearly smooth.

Cortinarius (Telamonia) umidicola Kauffm. f. *coeruleus* Moser & Ammirati, f.nov. (Fig. 22)

Differt a typo in pileo primo pallide coeruleo lamellisq. primo obscure violaceis. Habitatio in silvis coniferis (*Picea engelmannii*, *Abies lasiocarpa*), Holotypus 91/391, Flagstaff Road, Teton National Forest, Wyoming, 1.IX.1991, leg. J.Ammirati, in herb. IB conservatur.

P i l e u s 45-110 mm across, hemispheric, then convex to applanate, young buttons pale bluish, Pearl Blue (R), soon becoming gray, Pale Purplish Gray (R) with

darker spots, disc pale brownish, Cinnamon Buff (R), this color increasing with age toward the margin, finally so all over, only slightly hygrophanous, the gray-brown wooly veil leaving patches on the margin, which are visible even in old specimens.

L a m e l l a e in young buttons deep violet, Dark Purple Drab (R), soon becoming brown, between Cinnamon Drab and Benzoe Brown (R), in old specimens Sayal Brown (R) or between Sayal Brown and Mikado Brown (R), emarginate, edges strongly eroded, up to 10 mm broad (= 2-3 x thickness of pileus context), subdistant to distant, L=60-80, l=(1)-2(-7), 10/ cm at the margin.

S t i p e clavate, 6-8 cm long, 10-20 mm above, base 18-30 mm thick, pale bluish at first, Pearl Blue (R), soon more gray with some patches and even more or less complet belts from the gray-brown veil, cortina copious, bluish-gray.

C o n t e x t in young specimens deep blue violet, Ramier-Blue and even Slate-Violet (R) in the cortex, strongly marbled and in the pileus paler except above the lamellae, in age becoming paler and even pallid in the pileus, Light Buff (R) in the bulb, watery gray-brown marbled in the upper part of the stipe, particularly in the cortex.

C h e m i c a l r e a c t i o n s: With KOH only slightly and slowly gray-brownish on pileus cuticle and context.

M i c r o s c o p i c a l c h a r a c t e r s: Basidiospores $8.7-10.4 \times 5.3-7 \mu\text{m}$, mean 9.4 ($S = 0.38$) $\times 5.9 \mu\text{m}$ ($S = 0.37$), $Q = 1.4-1.8$, mean 1.6 ($S = 0.08$), $V = 129-265$, mean 173 ($S = 28.7$), ellipsoid, moderately verrucose. Basidia $41-43 \times 8.0-8.5 \mu\text{m}$, 4-spored, uteriform-clavate. Clamp connections present.

H a b i t a t: around a rotting log under *Picea engelmannii* and *Abies lasiocarpa*.

Collection examined: **Wyoming**: 91/391 (holotype IB, isotype JFA 10337) Flagstaff Road ("Calypso" Creek ³), about 1.5 miles from eastern end, Teton National Forest, 01-09-1991, leg. J.Ammirati.

C o m m e n t: A detailed description of the type variety and a discussion of the synonymy for *Cortinarius umidicola* will be given in part 2 of the series.

Section *Bovini* Mos.

Key to species:

1. Spores $10-12.5 \times 6.5-8 \mu\text{m}$. Pileus 3-8 cm, $\pm$ dark red-brown, fading to pale red-brown, Cinnamon, stipe clavate, 2.5-8.0 cm $\times$ 8-17 mm, base up to 30 mm thick, apex whitish to grayish, lower half covered with fuscous belts and patches from veil. Under *Abies* and *Picea*.

C. fusco-peronatus Kühner

1. Spores smaller. Colors of basidiomata different 2
2. Spores $8-10.7 \times 4-5 \mu\text{m}$. Pileus 3.5-6.5 cm, grayish brown at first, later darker

³ This is a little, nameless creek which we called "Calypso Creek" because of the occurrence of *Calypso bulbosa* in that ravine.

- umber brown when moist, gray-brown when faded. Stipe clavate, 3-7 cm x 8-17 mm, base up to 30 mm, silvery grayish, lower half with gray-brown to pale fuscous veil, at first peronate, later broken up into several belts. Under Conifers. *C. pseudobovinus* Moser & McKnight
- 2*. Spores 8-9 x 5-6 μm . Pileus dingy brown (hazel), 3-7 cm, stipe clavate-bulbous, 3-6 cm x 20-35 mm, pale brownish, gray-brown veil forming (sometimes incomplete) belts in the lower half. Under *Picea*. (Not yet recorded from North America *C. bovinus* Fr. ss.Fr. (non ss.Lge.)

Cortinarius (Telamonia) pseudobovinus Moser & McKnight spec. nov.
(Fig. 23, 39)

Pileo 3.5 - 6.5 cm lato, convexo, margine inflexo, dein plano-convexo, hygrophano, nec striato, primo griseo-brunneo, sericeo e velo griseo, dein obscuriore umbrino, sicco pallide griseo-brunneo, ad marginem velo persistente etiam aetate propecta, lamellis brunneis, emarginatis, acie subseriulato, confertis usque subdistantibus, 6-8 mm latis, stipite 3-7 cm longo, ad apicem 8-17 mm, basi 17-30 mm crasso, clavato, leviter longitudinaliter innato-fibrilloso, apice griseo-argenteo, infra cortinam e velo fusco peronato, dein zona cinguliforme vel zonis flocculosis adpressis praedito, carne albida usque pallide brunneola, odore subnullo, sapore miti. Cuticula carneque KOH ope reactionem nigro-brunneam praebente. Sporis 8-10.7 x 4-5.3 μm , ellipticis, elongatis, punctatis, basidiis tetrasporigeris, absque cheilocystidiis.

Habitatio in silvis coniferis (*Picea engelmannii*, *Pinus contorta*), holotypus 89/300, prope lacum "Lake of the Woods", in vicinitate jugi dicti "Union", Teton National Forest, Wyoming, leg. V. McKnight, 21.VIII. 1989, in herb. IB conservatur.

Pileus 3.5-6.5 cm across, convex with incurved margin, later more plano-convex, hygrophanous, not translucent-striate when moist, grayish brown when young (somewhat reminiscent of *C. caninus*), Caill 50R, silky due to the veil covering, later dark umber brown when moist, Caill 47S to 69S, in dry condition paler gray brown, center more gray, Wood Brown (R), more brownish toward margin, veil remnants near margin visible even in age and the surface is shiny also in old specimens.

Lamellae milk-coffee-brown, gray brown, Sayal Brown (R), strongly emarginate, edges eroded, close to subdistant, L = about 60, l = 1-3, 12-13/cm at the margin, 6-8 mm broad (= 5-6 x thickness of the pileus context).

Stipe 3-7 cm long, 8-17 mm at apex, base 17-30 mm thick, clavate, silvery grayish at the apex, somewhat longitudinally innately fibrillose, the lower half or third covered by grayish brown to pale fuscous universal veil, which forms a pale gray-brown peronate covering in young specimens, in adults one or several appressed to floccose belts can be present.

Context whitish to pallid brownish. Odor lacking or sometimes slightly fungacious, taste mild.

Chemical characters: With KOH dark blackish brown both on the pileipellis and context. Under UV pileus red, lamellae dark red, stipe and context purplish violet.

Microscopic characters: Basidiospores 8-10.7 x 4-5.3 μm , mean 9.25 (S = 0.51) x 4.6 μm (S = 0.24), Q = 2, V = 78-139, mean 103 (S = 12.4), elongate elliptical, punctate. Basidia 35-38 x 8-9 μm , 4-spored, with basal clamp

connections. Cheilocystidia lacking. Pileipellis upper layer of radially arranged hyphae, 5-9 μm diameter, with some clamp connections, beneath this layer a thick brown pigmented layer (wall pigments) with hyphae 10-22 μm wide, below this layer similar hyphae but without pigmentation and becoming more irregular deeper in the trama.

H a b i t a t: under *Picea engelmannii* and *Pinus contorta*.

Collection examined. **Wyoming:** 89/300 (holotype IB, isotype BRY), Lake of the Woods, Union Pass, Teton National Forest, 21-08-1989, leg. V.McKnight.

C o m m e n t s: *Cortinarius pseudobovinus* bears a close resemblance to *C. bovinus* Fr. It has a similar type of fuscous universal veil and the same habit. It differs, however, by more gray colors and the elongate, elliptical spores.

Cortinarius (Telamonia) fuscoperonatus Kühn. (1955)
(= *Hydrocybe tigrina* Mos. (1953), nom.inval. non Johns.)
(Fig. 24, 40)

P i l e u s 3.5-8 cm broad, convex, sometimes slightly umbonate or margin somewhat undulate or crenulate, hygrophanous, not translucently striate when moist, matt, finely fibrillose under a lens, color more or less dark red-brown when moist, Mikado Brown (R), center Russet or Mars Brown (R), margin paler near Ochraceous Tawny or Sayal Brown (R) or even paler, very young buttons can be more grayish brown, drying centripetally or somewhat radially, becoming near Cinnamon (R), older specimens occasionally becoming slightly scaly.

L a m e l l a e dark coffee-brown to dark rust brown, Cinnamon Brown to Russet (R), shallowly but broadly emarginate, distant, L about 45-60, l= 1-3, 7-9/cm at the margin, 5-9 mm wide (= 3-6 x thickness of the pileus context).

S t i p e 7-9.5 cm long, 10-25 mm thick above, 15-40 mm at the base, pale grayish brown, somewhat shiny, below the cortina with dark gray-brown, fuscous belts from the universal veil particularly in the lower half or two thirds, stuffed to hollow.

C o n t e x t pallid in the pileus, pale cork brown, Pale Ochraceous Buff (R) in the pileus, darker brown in the stipe. Odor slightly fungacious when cut, taste mild.

C h e m i c a l c h a r a c t e r s: KOH colors the pileipellis slowly blackish brown, the context gray-brown. Under UV indistinctly purplish, the lamellae dark.

M i c r o s c o p i c c h a r a c t e r s: Basidiospores 10-11.4(-12.5) x 6.5-8 μm , mean 10.8 (S = 0.45) x 7.3 μm S = 0.32), Q = 1.5 (1.37-1.68), V = 237-375, mean 304 (S = 34.8), ellipsoid, verrucose. Basidia 40-43 x 10-11 μm , 4-spored, clavate, with basal clamp connections. Epicutis of repent hyphae, 5.5-8.5 μm thick, walls yellow-brown, hypodermium of subcellular elements, 18-28 μm thick, walls pale yellowish. Hyphae of the trama 8-16 μm thick, in lower part pseudoparenchymatous, in upper part radially arranged. Hyphae of veil from stipe 6-8 μm wide, walls pale gray brown, sometimes slightly encrusted. Clamp connections present.

H a b i t a t: Under *Abies lasiocarpa*, sometimes mixed with *Picea engelmannii*.

Collections examined: **Wyoming:** 89/165 (IB, BRY), Fourmile Meadow, Teton National Forest, 05-08-1989; 89/271 (IB, BRY and JFA 9974), same area but other site, 18-08-1989; 91/215 (IB, BRY) 2.5 km west of Togwotee Lodge, Teton National Forest, 09-08-1991.

C o m m e n t s : The American collections of *Cortinarius fuscoperonatus* agree fully with European material. In Europe the species is also mostly frequently found under *Abies* but also occurs under spruce. From *C. pseudobovinus* it can be distinguished easily by the larger size, by the browner colors and the different spore shape and size. Collection 16348 of A.H. Smith from Mount Baker, Washington, could at first glance suggest this species, but has distinctly smaller spores (9-10.2 x 6-6.5 μ).

Acknowledgements. We gratefully acknowledge our debt to the University of Wyoming and the National Park Service for the use of the facilities of the Research Center at Moran, Wyo, to the National Park Service Officers of Research for permission to collect and study in Yellowstone and Grand Teton National Parks. We want to thank Prof. Harry D. Thiers and Prof. O.K. Miller Jr. for kindly reviewing and commenting the manuscript.

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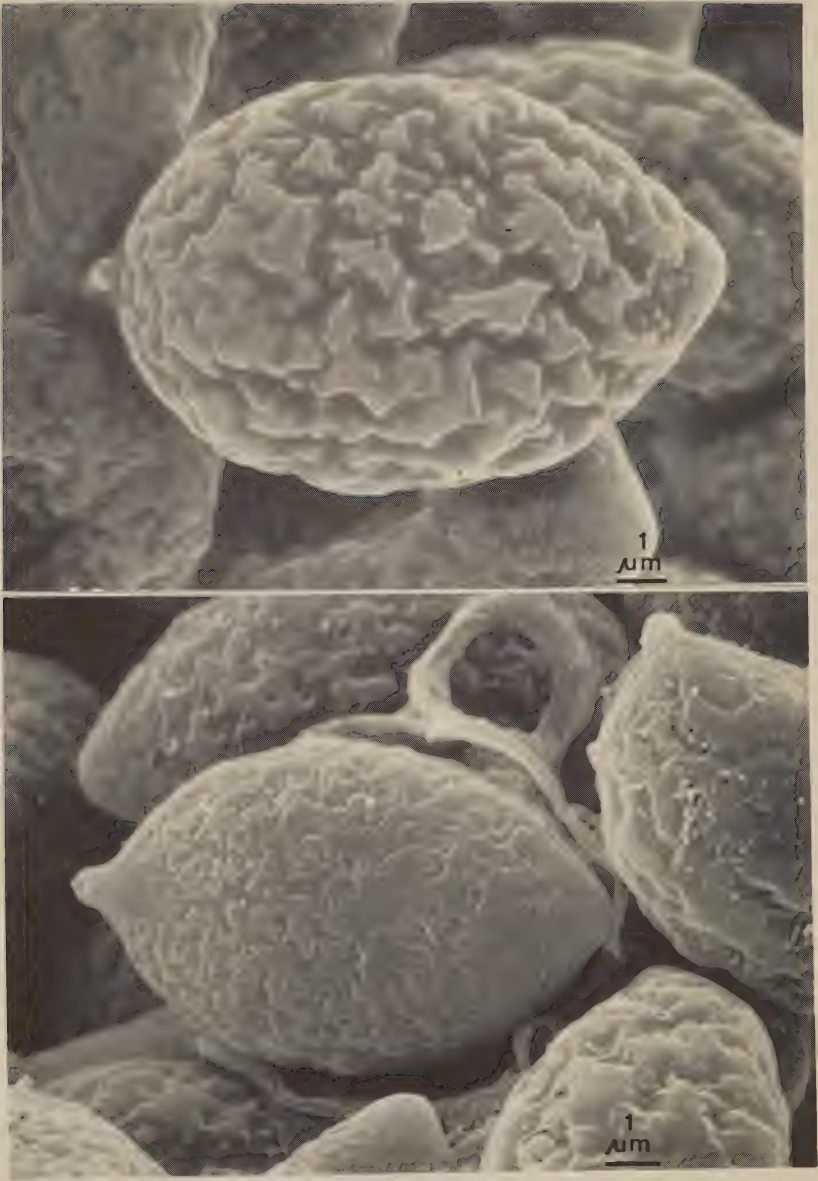


Fig.1 a and b. Basidiospores of *Cortinarius aurora*. Bar = 1 µm.

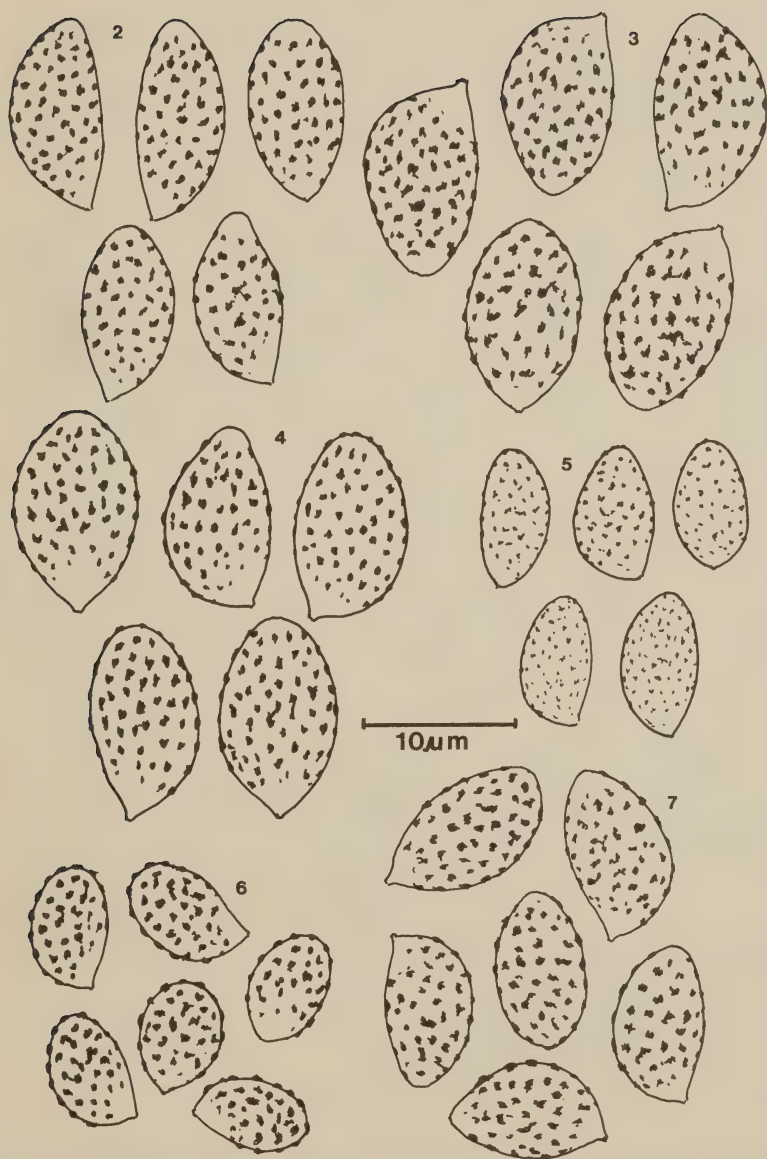


Fig. 2-7 Basidiospores of: 2. *Cortinarius albobrunnoides* coll. 91/237. 3. *Cortinarius aurora* coll. 89/228. 4. *Cortinarius fraudulentus* coll. 87/155. 5. *Cortinarius papulosus* coll. 87/278. 6. *Cortinarius subfoetens* coll. 89/307. 7. *Cortinarius cephalixoides* coll. 87/188. (all x 2000)

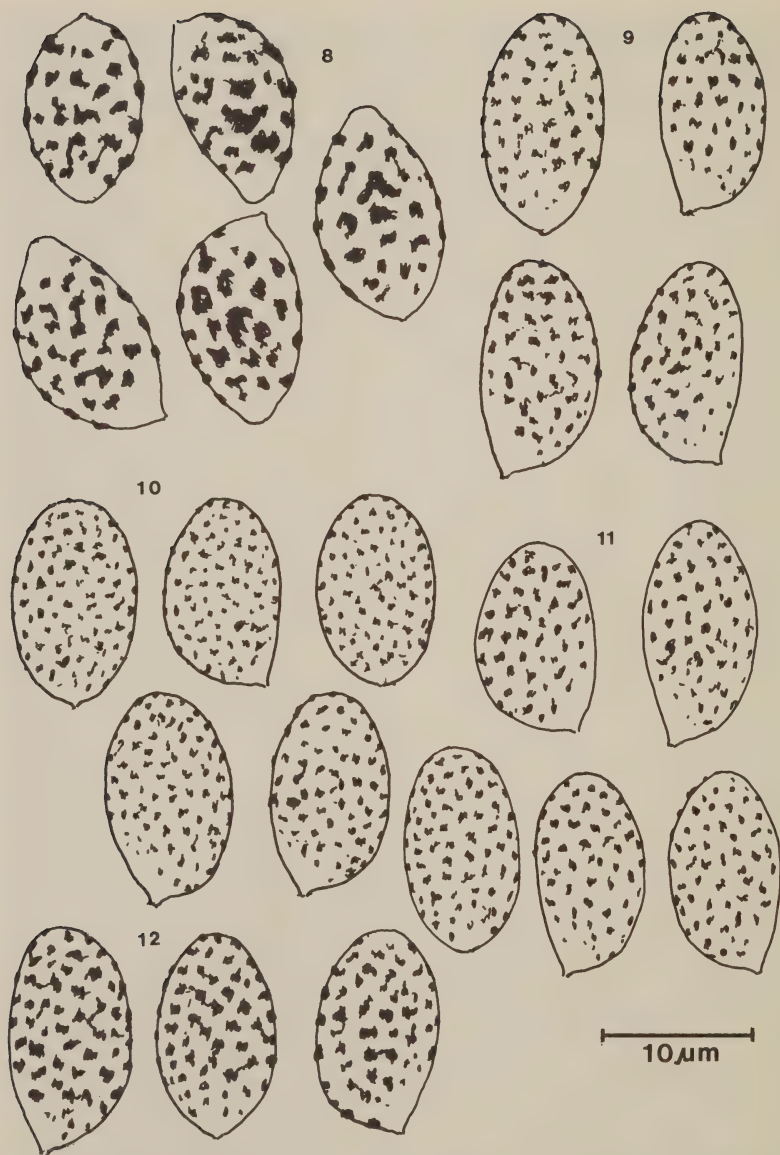


Fig.8-12. Basidiospores of: 8. *Cortinarius elotoides* coll. 87/60. 9. *Cortinarius pseudoarquatus* A.H.Smith 1714, holotype. 10. *Cortinarius fulvoochrascens* coll.87/344. 11. *Cortinarius fulvoochrascens* coll.71/202. 12. *Cortinarius fulvoochrascens* var. *subcaninicolor* coll. 87/218. (all x 2000)

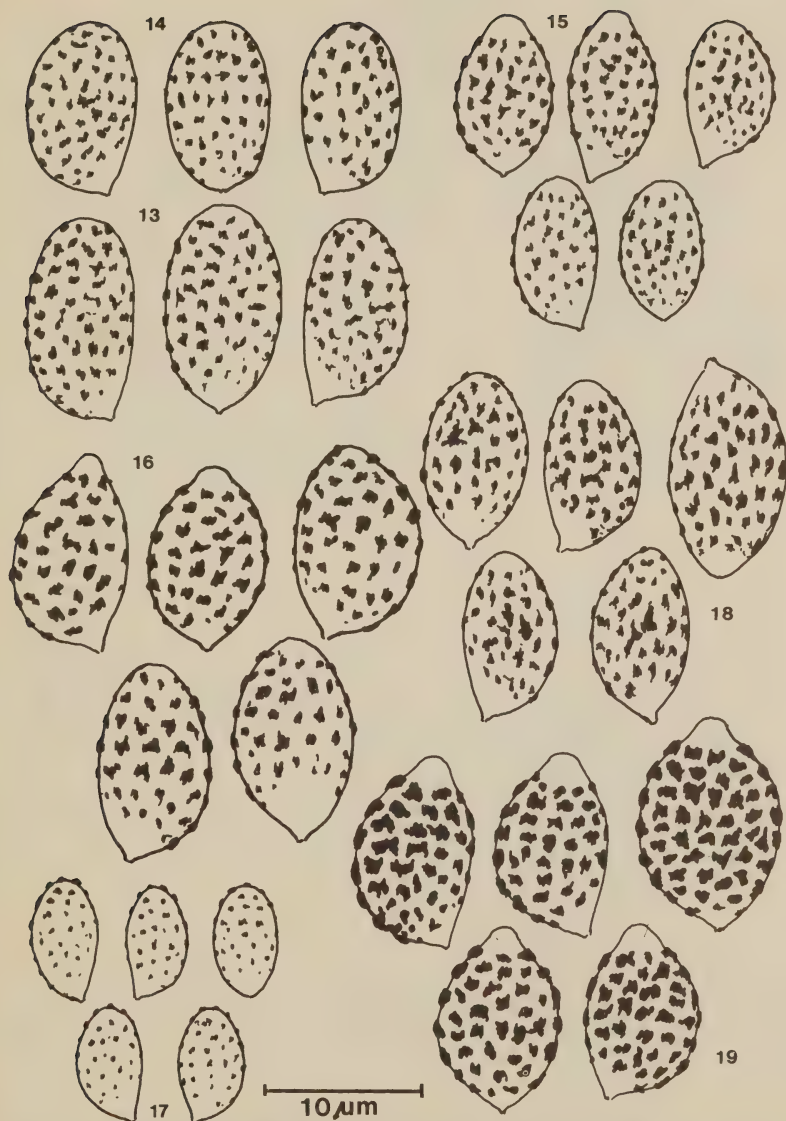


Fig. 13 -19 Basidiospores of: 13. *Cortinarius fulvoochrascens* coll. 91/371. 14. *Cortinarius fulvoochrascens* coll. 89/474. 15. *Cortinarius aureopulverulentus* coll. 89/474. 16. *Cortinarius aureofulvus* coll. 87/197. 17. *Cortinarius elegantior* var. *americanus* coll. 89/59. 18. *Cortinarius flavaurora* coll. 89/187. 19. *Cortinarius resinaceus* coll. 87/265. (all x 2000)

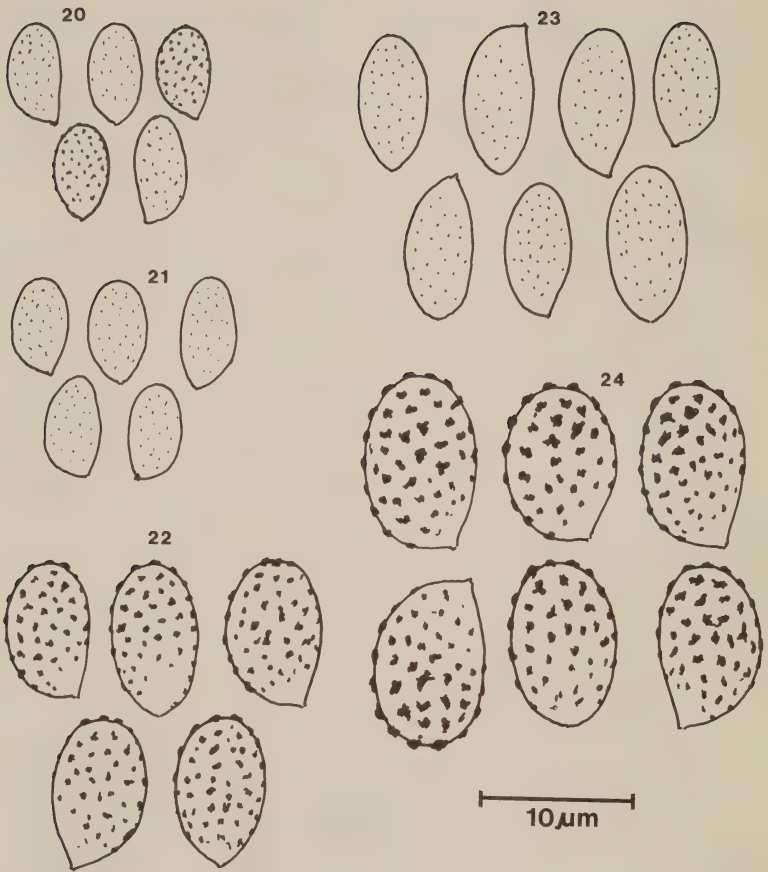
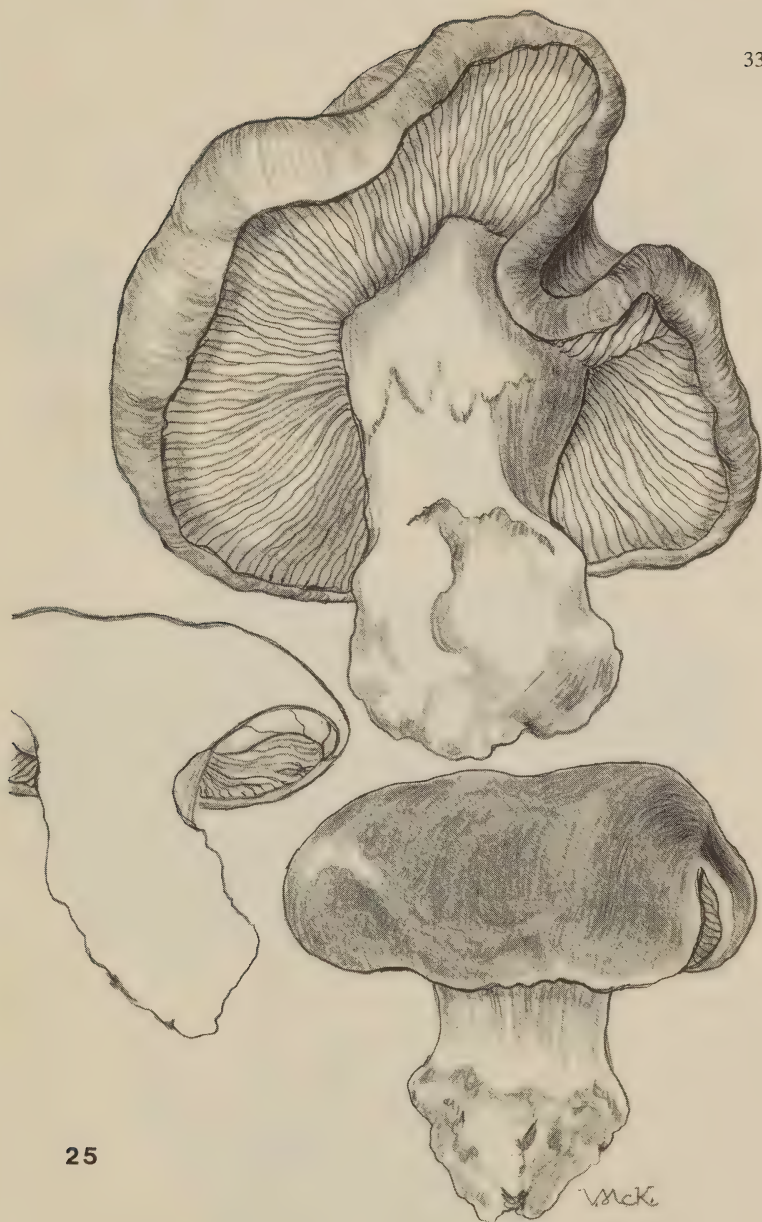


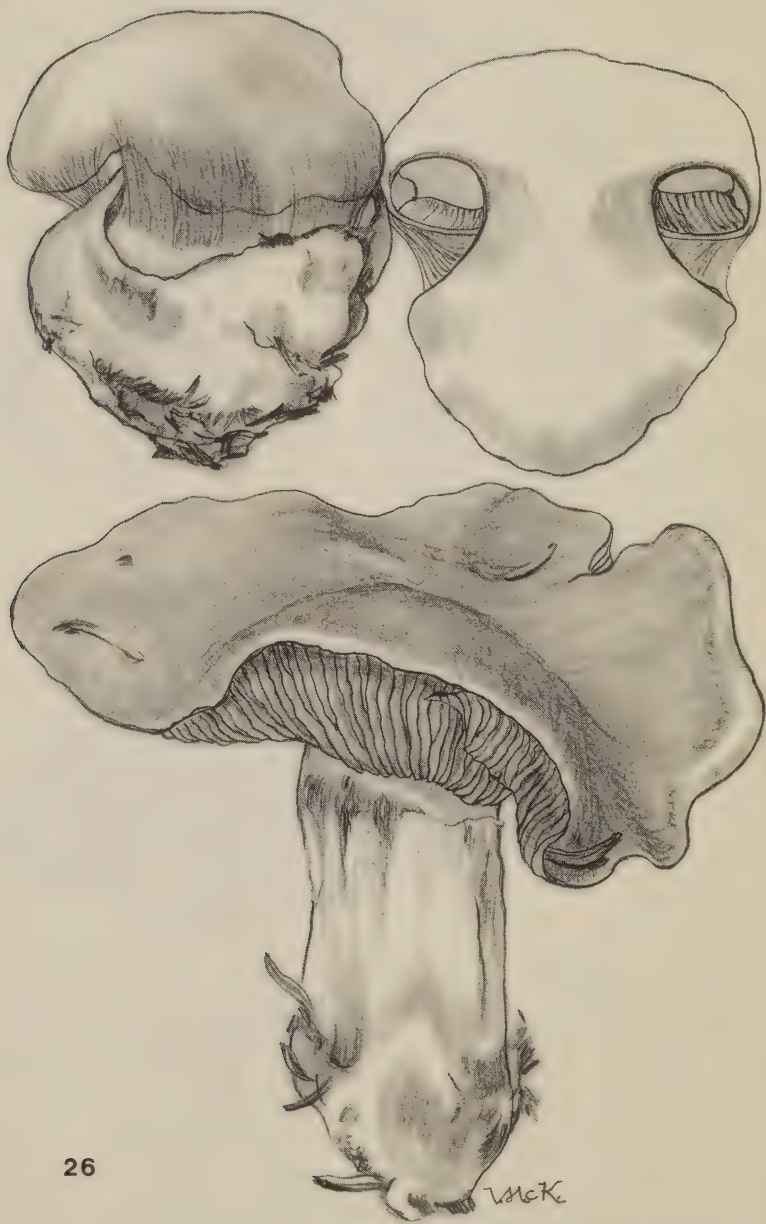
Fig. 20-24. Basidiospores of: 20. *Cortinarius umbilicatus* coll. 87/282.

21. *Cortinarius umbilicatus* holotype, Karsten, Mustiala. 22. *Cortinarius umidicola* var. *coeruleus* coll. 91/391. 23. *Cortinarius pseudobovinus* coll. 89/300. 24. *Cortinarius fuscoperonatus* coll.89/165.(all x 2000)



25

*Cortinarius albobrunnoides*Fig. 25. Basidiomata of *Cortinarius albobrunnoides* (91/237)(nat.size)

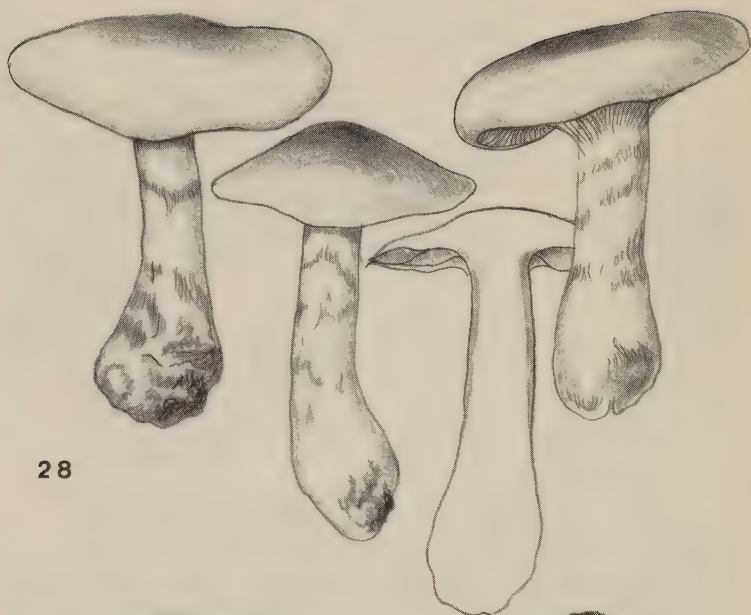


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Fig. 26. Basidiomata of *Cortinarius aurorea* (89/227) (nat. size)



Fig. 27. Basidiomata of *Cortinarius fraudulosus* (87/165, 91/338 & 87081309)(nat. size)



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29

Fig. 28. Basidiomata of *Cortinarius papulosus* (87/278)(nat. size)

Fig. 29. Basidiomata of *Cortinarius cephalixoides* (87/188 and 87/195)(nat.size)

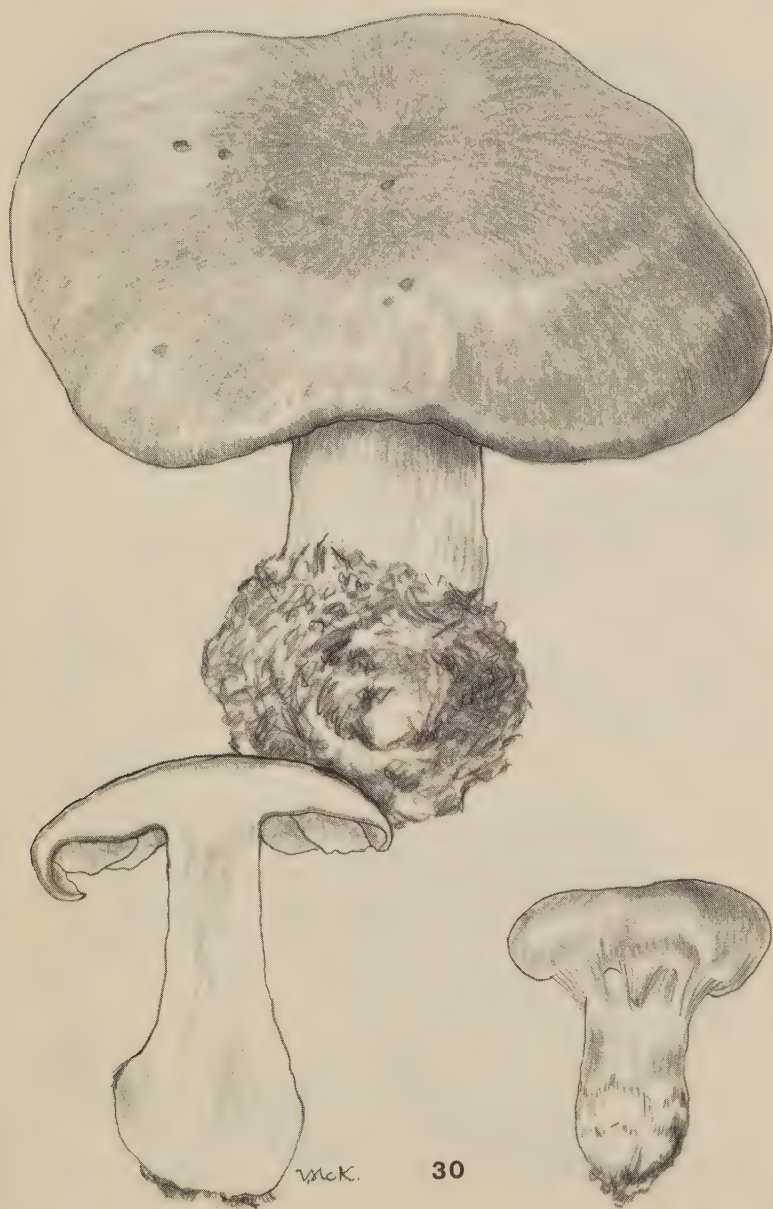


Fig. 30. Basidiomata of *Cortinarius subfoetens* (89/307)(nat.size)



Fig. 31. Basidiomata of *Cortinarius elotoides* (87/40)(nat.size)



Fig. 32. Basidiomata of *Cortinarius fulvoochrascens* var. *subcaninicolor* (87/218)(nat.size)
 Fig. 33. Basidiomata of *Cortinarius aureofulvus* (87/221)(nat.size)

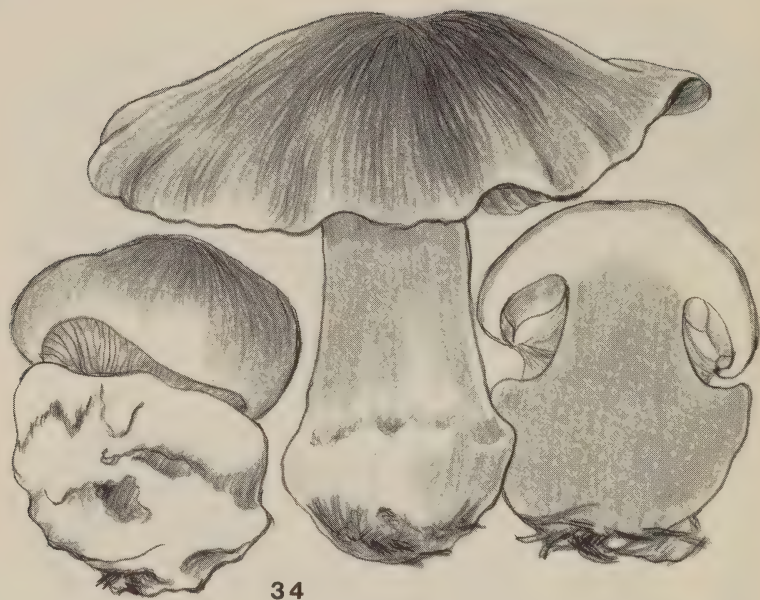
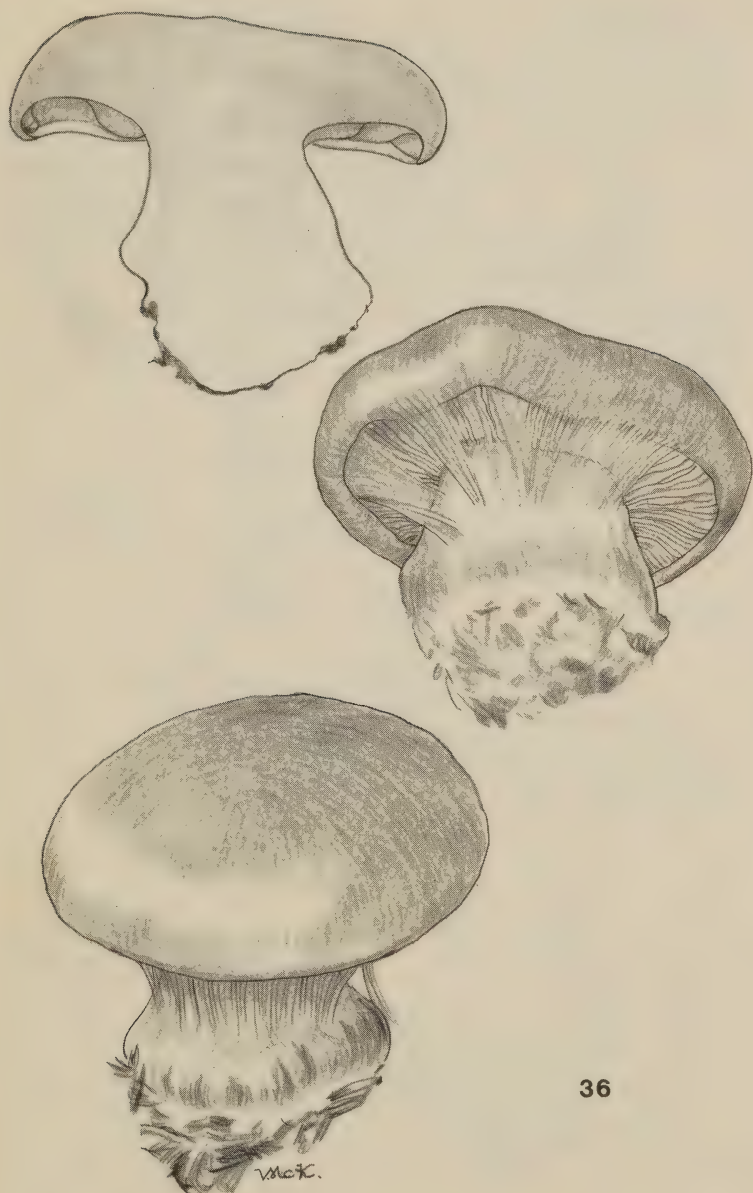


Fig. 34. Basidiomata of *Cortinarius aureopulverulentus* (89/197)(nat.size)
 Fig. 35. Basidiomata of *Cortinarius umbilicatus* (87/96)(nat.size)



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Fig. 36. Basidiomata of *Cortinarius elegantior* var. *americanus* (83/163)(nat.size)

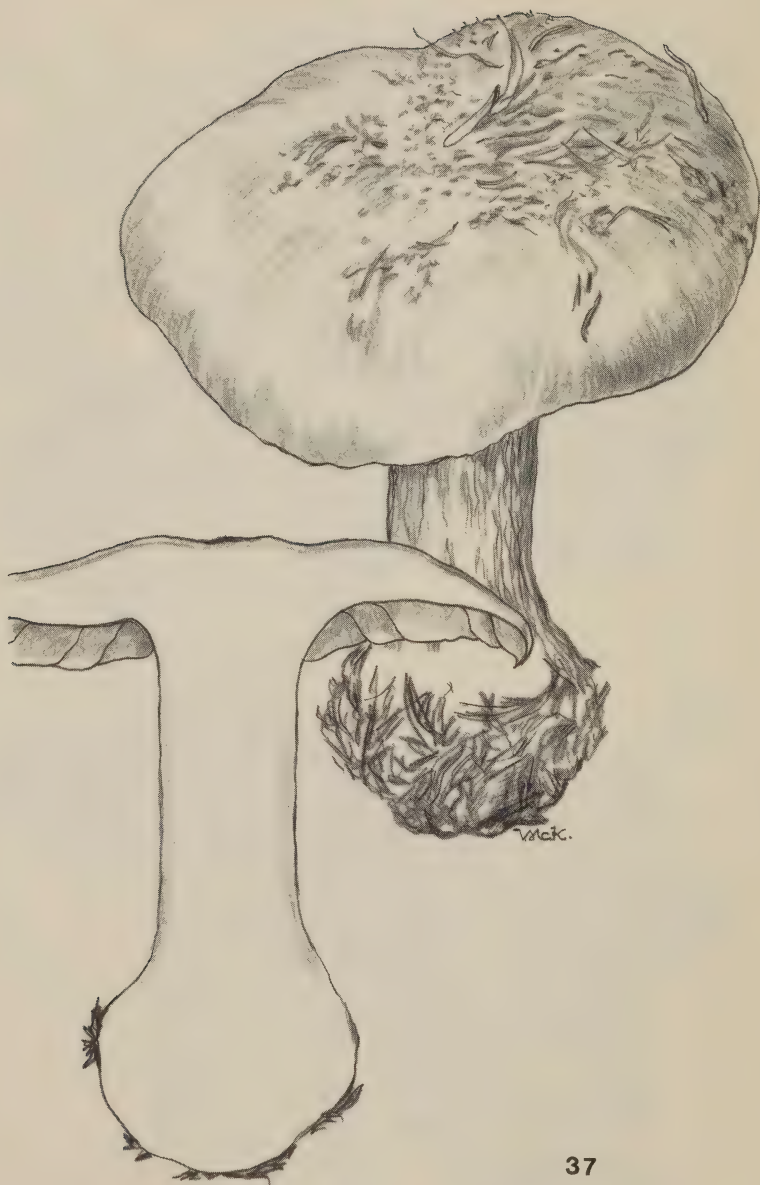


Fig. 37. Basidiomata of *Cortinarius flavaurora* (89/210)(nat.size)

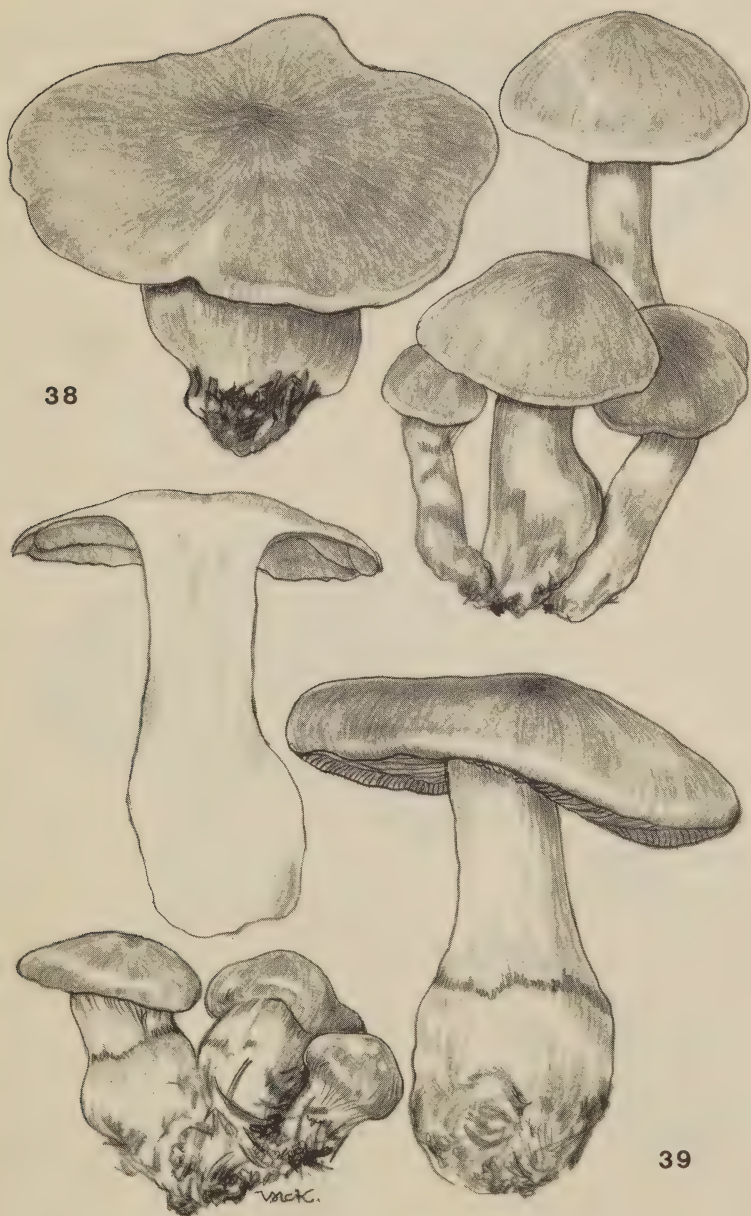


Fig. 38. Basidiomata of *Cortinarius resinaceus* (89/390)(nat.size)

Fig. 39. Basidiomata of *Cortinarius pseudobovinus* (89/300)(nat.size)



Fig. 40. Basidiomata of *Cortinarius fuscoperonatus* (89/165)(nat.size)

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AMAUROASCUS PURPUREUS, A NEW SPECIES OF THE AMAUROASCACEAE (ASCOMYCOTINA)

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ABSTRACT

Amauroascus purpureus sp. nov. isolated from cultivated soil in Japan, is described and illustrated. It is characterized by small and irregularly reticulate ascospores with frilled rims, vinaceous purple ascomata and by the production of pigment of the same color into the medium. A partly revised key to the species of Amauroascus is given.

Key words—Amauroascus purpureus; soil fungus; species key to Amauroascus.

During a survey of the fungal flora of soils in Osaka, Japan, an undescribed gymnoascaceous fungus was isolated. The fungus is distinguished from other known species of Amauroascus Schroeter (von Arx, 1971; Benny and Kimbrough, 1980; von Arx, 1987; Currah, 1988; Cano and Guarro, 1989) by irregularly reticulate ascospores with frilled rims, vinaceous purple ascomata and by the production of pigment of the same color into the medium. Based on these characters, description and illustration of the fungus as a new taxon are provided.

Amauroascus purpureus T. Ito et Nakagiri sp. nov.

Figs. 1-7.

Coloniae in agaro OA restrictae, velutinae, hyalinae vel pallide luteae; reversum atropurpureus. Ascomata solitaria, globosa vel subglobosa, 200-400 μ m diam, mollia, hyalina, cum hyphis laxae intertextis oblecta. Hyphae "racquet" dictae praesentes. Hyphae peridii pallide luteae vel plus minusve purpureae, distinguibili nulla, crasso-parietales, 2-3 μ m. Asci breviter catenulati, octspori, subglobosi vel ovati, 11-15 x 6-8 μ m, evanescentes. Ascosporae hyalinae vel pallide brunneae, globosae, irregulariter reticulatae, 2.8-3.2 μ m, canaliculatae labri. Status anamorphus non visus.

Holotypus: IFO H-12173, colonia exsiccata in cultura ex solo, Ikeda, Osaka, Japonia, iv 1990, e cultura IFO 32622.

Etymology: from the Latin, purpureus = purple; referring to the pigment production into the medium.

Colonies on oatmeal agar (OA) growing slowly, attaining a diameter of 48-52 mm within 3 weeks at 24 °C, velvety, partly immersed, often with sectors, white to pale yellow (Rayner, 1970); reverse pale yellow at first, later becoming dark purple. Racquet hyphae present. Ascomata solitary, globose to subglobose, maturing within one month, 200-400 μ m in diam, soft, covered with white to pale brown or purple, loosely interwoven hyphae; ascomatal initials appeared as terminal or side branches of the vegetative hyphae, consisting of

loosely coiled hyphae. Peridial hyphae pale yellow to pale purple, undifferentiated when young, becoming thick-walled, slightly rough with age, 2-3 μm diam. Asci in short chains, 8-spored, subglobose to ovate, 11-15 x 6-8 μm , evanescent. Ascospores hyaline to pale brown in mass, globose with frilled rims, giving a irregularly reticulate appearance, 2.8-3.2 μm in diam excluding frilled rims. Anamorph is absent. The fungus is not kelatinolytic and the major ubiquinone is Q-10(H_2).

At 37 °C, growth is nil.

Specimen examined: IFO 32622 (T. Ito H2-4-15-11), culture isolated from cultivated soil at Ikeda, Osaka, Japan, May, 1990.

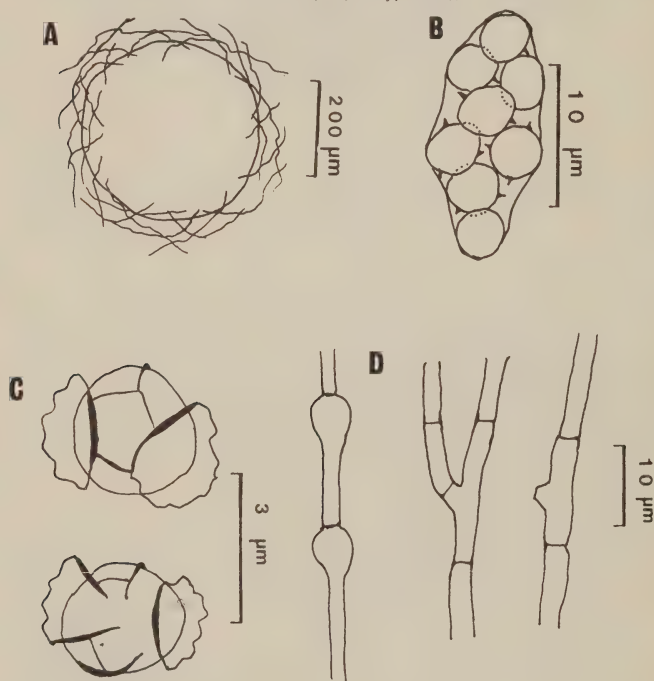
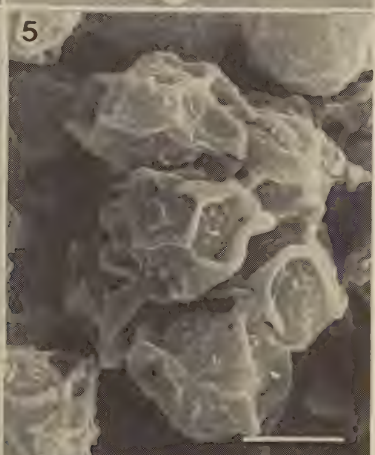
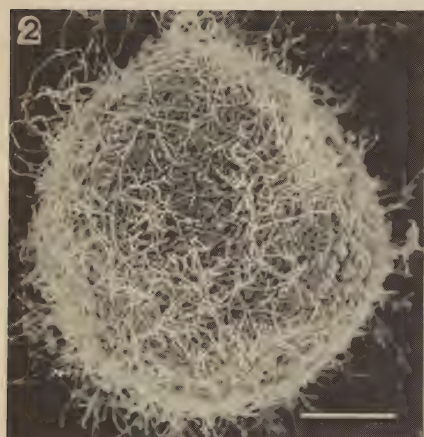


Fig. 1. *Amauroascus purpureus* (IFO 32622). A. Ascoma. B. Ascus and ascospores. C. Ascospores. D. Racquet and peridial hyphae.

Figs. 2-6. Scanning and light micrographs of *Amauroascus purpureus* (IFO 32622). 2. Ascoma. 3. Asci. 4 and 5. Ascospores. 6. Ascomatal initial. 7. Ascospores of *A. niger* (IFO 32599).

Bars: 2 = 100 μm . 3, 4 and 6 = 20 μm . 5 and 7 = 2 μm .



For comparison, the following strains were examined: Arachniotus aureus (Eidam) Schroeter (IFO 31763), Amauroascus niger Schroeter (IFO 32529=CBS 114.61), A. verrucosus (Eidam) Schroeter (IFO 32600=CBS 227.69; IFO 32601=CBS 181.70), A. kuehnii von Arx (IFO 32371), A. echinulatus (Dutta & Ghosh) von Arx (IFO 9192).

Colonies on each medium show the following growth after 3 weeks' incubation at 24 °C.

On potato carrot agar: growing moderately, attaining a diameter of 48-52 mm, velvety, thin, partly immersed, white; reverse uncolored. On malt extract agar: growing moderately, attaining a diameter of 55-65 mm, velvety to floccose or funiculose at the center, white or purplish gray at the central part; reverse pale brown to grayish blue or violet slate at the center. On yeast phosphate soluble starch agar: growing moderately, attaining a diameter of 64-66 mm, velvety, thin, partly immersed, white to pale gray; reverse uncolored to pale gray.

Taxonomical disposition of the genus Amauroascus in the family Amauroascaceae v. Arx has been discussed by von Arx (1971, 1977b, 1987), Currah (1985, 1988), Cano and Guarro (1989), and Guarro et al. (1992). Furthermore, Guarro et al. (1991) reevaluated the genus Nanizziopsis Currah as a related genus which is characterized by white ascomata, asperulate peridial hyphae constricted at septa, hyaline and globose ascospores, and a Chrysosporium Corda anamorph. Recently, Guarro et al. (1992) established the genus Amauroascopsis Guarro et al. with globose ascospores surrounded by a loose pitted epispore (sheath) as a genus similar to Amauroascus. The present isolate, however, differs from Nanizziopsis and Amauroascopsis mainly by the absence of sheathed ascospores. In addition, no Chrysosporium anamorph is observed. The ascospores of the related genus Arachnotheca v. Arx have a membranous or mucilaginous sheath, it is distinguished from the new fungus by having an anamorph with arthroconidia separated by disjunctives. According to Currah (1985) and von Arx (1987), ascomata covered with undifferentiated interwoven hyphae and spherical ascospores without membranous sheath are typical characteristics of the members of the genus Amauroascus. We therefore propose a new species in Amauroascus to accommodate this fungus.

Species of Amauroascus are distinguished on the basis of ascospore size, color, morphology, and on characteristics of the peridial hyphae.

The fungus Amauroascus purpureus closely resembles A. niger in their globose, reticulate ascospores, but the ornamentation pattern of those of the latter are more regular (Fig. 7) and they are bigger (4.5-6 µm). The typical ornamentation and the purple ascomata differentiate this species from the rest of the genus.

Cano and Guarro (1989) assigned eight species into Amauroascus and provided a key to this genus. We follow their species concept and provide a partly revised key to species in the genus.

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We are grateful to Drs. Guarro and Cano, Universitat Rovira i Virgili, Spain, for reviewing the manuscript and for useful suggestion. We also thank

Centraalbureau voor Schimmelcultures (CBS) for kindly providing some cultures of related species.

Key to the species of Amauroascus

1. Ascospores verrucose or echinulate ----- 2
1. Ascospores reticulate ----- 3
2. Ascospores echinulate, 4.5-5.5 μ m diam; anamorph unknown -----
----- A. echinulatus (Dutta & Ghosh) v. Arx
2. Ascospores verrucose-tuberculate, 6-8 μ m diam; anamorph in Malbranchea
----- A. mutatus (Quelet) Rammeloo
3. Ascomata with thick-walled, differentiated peridial hyphae ----- 4
3. Ascomata with thin-walled, undifferentiated peridial hyphae ----- 6
4. Ascomata white ----- A. volatilis-patellis (Orr & Kuehn) Currah
4. Ascomata yellow, ochraceous or brown ----- 5
5. Ascomata yellow, or browning with age; ascospores yellowish brown,
4-4.7 μ m diam; arthroconidia present ----- A. kuehnii v. Arx
5. Ascomata ochre-olivaceous; ascospores golden yellow, 5-6 μ m diam;
anamorph absent ----- A. pseudoreticulatus Currah
6. Ascospores ellipsoid, 2.3-3 X 2-2.5 μ m ----- A. oblatum Cano & Guarro
6. Ascospores globose and larger ----- 7
7. Ascomata yellow; ascospores hyaline to pale yellow, 3.3-5.5 μ m diam;
anamorph in Chrysosporium ----- A. aureus (Eidam) v. Arx
7. Ascomata white; ascospores brownish with age ----- 8
8. Ascospores 4.5-6 μ m diam; anamorph in Malbranchea ----- A. niger Schroeter
8. Ascospores 2.8-3.2 μ m diam; anamorph absent- A. purpureus T. Ito & Nakagiri

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FURTHER NOTES ON THE LICHEN GENUS *PORINA* (TRICHOTHELIACEAE) IN TASMANIA AND NEW ZEALAND

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ABSTRACT

Porina exacta sp. nov. is described. The new taxon resembles *P. elegantula* Müll. Arg., but differs in having larger perithecia and ascospores which are wider and consistently 15-septate. *Porina impolita* P.M. McCarthy, previously known from subtropical latitudes in eastern Australia, is reported from cool-temperate rainforest in Tasmania.

Since the recent accounts of the lichen genus *Porina* Müll. Arg. (Trichotheliaceae) in Australasia by McCarthy (1993, 1994) and McCarthy & Kantvilas (1993), ongoing field work in Tasmania and New Zealand has led to the discovery of one further new species and a marked extension in the range of another. These data are presented below.

Porina exacta Malcolm, P.M. McCarthy & Kantvilas *sp. nov.*

Fig. 1

Thallus pallido fuscoviridis, continuus vel rimosus, aequalis vel minute rugulosus, hebetatus vel leviter nitidus, 40-80 μm crassus, sine prothallo distincto, corticola vel saxicola. Algae 6-12 x 6-10 μm . Perithecia superficialia, rubrofusca, hemisphaerica vel subglobosa, numerosa, vulgo solitaria, maturitate (0.3-)0.4(-0.5) mm diametro. Ostiolum vulgo inconspicuum. Involucrellum alga continens, usque ad 60 μm crassum, in sectione aurantiacofuscum. Excipulum pallido aurantiacofuscum, circa 28 μm crassum. Centrum 0.2-0.33 mm diametro. Asci elongato-cylindrici, apicibus obtusis vel subtruncatis, 113-160 x 14-18 μm crassum. Paraphyses simplices, 0.7-1.0 μm crassae. Ascosporae semper 15-septatae, elongatae-cylindricae, rectae, apicibus paulo obtusis, in ascis parallelae, haud halonatae, 58-97 x 4-6. Conidiomata non vidi.

Type. New Zealand, South Island, Nelson, Hira, Conifer Track 300 m from junction with Waterfalls Track, 41°16.0'S, 173°24.4'E, NZMS 260:O-27:441935, on siliceous rock in lowland forest dominated by *Nothofagus* and *Dicksonia*, alt. 410 m, 3 vii. 1994, W. Malcolm 2011 (CHR-holotype).

Thallus pale brownish green, continuous to rimose, smooth to minutely rugulose, matt to slightly glossy, 40–80 μm thick, lacking a visible prothallus, on either bark or siliceous rock. *Algae* 6–12 $\times$ 6–10 μm . *Perithecia* superficial, reddish brown, hemispherical to subglobose, sometimes overgrown at the base by the thallus, numerous, usually solitary, at full maturity (0.3–)0.4(–0.5) mm in diameter. Ostiole usually inconspicuous. *Involucrellum* containing algae, to 60 μm thick, orange-brown in section, contiguous with the excipulum for about two-thirds of the perithecium's height, but arching away and effuse toward the base. *Excipulum* pale orange-brown, about 28 μm thick. *Centrum* 0.2–0.33 mm in diameter. *Asci* elongate-cylindrical, with rounded or subtruncate apices, 113–160 $\times$ 14–18 μm . *Paraphyses* unbranched, 0.7–1.0 μm thick. *Ascospores* consistently 15-septate, elongate-cylindrical, straight, both ends rounded, sometimes slightly broader towards distal end, parallel in the ascus, without a gelatinous sheath, 58–97 $\times$ 4–6 μm (29 spores measured). *Conidiomata* not seen.

Additional specimen examined.

Australia, Tasmania, Anthony Road, Site 475, 41°49'S, 145°38'E, on bark of *Atherosperma moschatum* in rainforest, alt. 520 m, 30 vi. 1993, G. Kantvilas 186/93 (HO).

Habitat and distribution: *Porina exacta* is known from single locations in Tasmania and the South Island of New Zealand. In Tasmania, it occurs on shaded trunks with smooth, moist bark in cool temperate rainforest of the callidendrous type (nomenclature after Jarman *et al.* 1994), where it associates with bryophytes, *Thelotrema lepadinum*, and incipient thalli of the foliose lichens *Psoroma microphyllizans* and *Pseudocypbellaria multifida*. This habitat is rather unique for Tasmanian corticolous *Porina* species in that with the exception of *P. sylvatica*, with which *P. exacta* also occurs, the other taxa are found mainly on twigs. In New Zealand, the new species occurs on siliceous rocks in shady lowland forest dominated by *Nothofagus* and *Dicksonia*.

Notes: The thallus and perithecia of *Porina exacta* most closely resemble those of *P. elegantula* (McCarthy & Kantvilas 1993), a species with smaller perithecia and ascospores which are shorter, 11–21-septate, and distinctly acicular to fusiform, 2–3 μm wide with acute apices. Moreover, *P. elegantula* appears to be a species of dry coastal vegetation. Also similar is *P. sylvatica* which has generally larger perithecia and markedly broader, typically fusiform ascospores. Remarkably, all the ascospores of *P. exacta* examined consistently had fifteen septa.

Porina exacta appears to be a very rare species, because extensive searches of both known localities failed to reveal any further populations. Whilst many of the saxicolous species of the genus are also apparently uncommon, being represented by very few or only one specimen (McCarthy 1993), this is unusual at least amongst the cool temperate corticolous species where ecological and floristic studies (Kantvilas & Jarman, unpubl.) have indicated that the other species can be locally quite abundant, albeit in a very restricted microhabitat. It is possible that *P. exacta* is more abundant in some hitherto unsampled habitat.

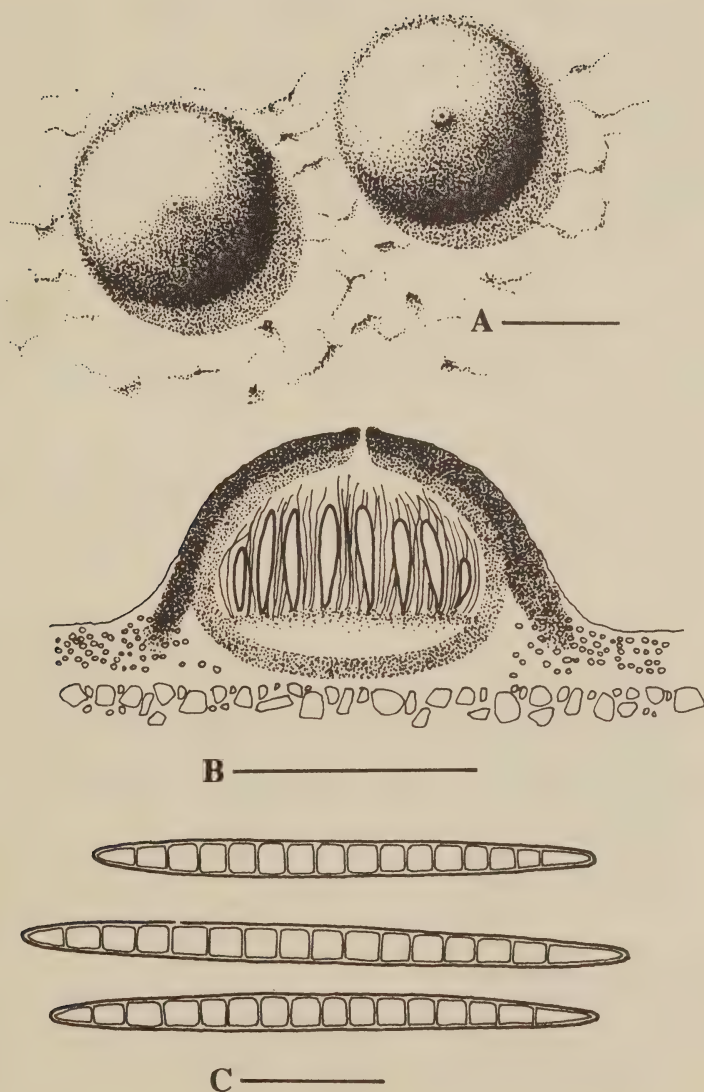


Fig. 1. *Porina exacta* (holotype). A, Habit, with perithecia; B, Vertical section through a perithecium; C, Ascospores. Scale A = 0.2 mm, B = 0.2 mm, C = 20 μ m.

Porina impolita P.M. McCarthy, *Nova Hedwigia* **58**: 394 (1994)

First described from dry *Nothofagus moorei* trunks in cool-temperate rainforest in northern New South Wales and from subtropical rainforest in south-east Queensland, this species is here recorded from Tasmania where it grows on small foliage twigs of *Anopterus glandulosus*, *Atherosperma moschatum*, *Athrotaxis selaginoides*, *Eucryphia lucida* and *Nothofagus cunninghamii* in deeply shaded rainforest understoreys. *Porina impolita* is a locally common component of a very typical twig association comprising *Arthopyrenia* spp., *Austroblastenia pupa*, *Catillaria kelica*, *Coccotrema cucurbitula*, *Opegrapha stellata*, *Porina hyperleptalea*, *P. leptalea* and *Thelotrema suecicum*. It has been recorded in Tasmania almost exclusively from rainforest of the *thamnic* type (nomenclature after Jarman *et al.* 1994).

Porina impolita is characterised by its medium greyish green, epiphloeodal thallus, flattened-hemispherical to subglobose, 0.24-0.62 mm diam. perithecia with an orange-yellow to medium orange-brown involucrellum, and consistently 7-septate, 25-29 x 5-10.5 μ m ascospores.

Selected Tasmanian specimens examined (total = 7):

Anthony Road, Site 474, 41°49'S, 145°38'E, alt. 480 m, 30 iv. 1993, G. Kantvilas 227/93 (HO); Anthony Road, Site 468, 41°50.5'S, 145°37.5'E, alt. 540 m, 12 xi. 1992, G. Kantvilas 557/92 (HO); Anthony Road, Site 471, 41°50.5'S, 145°36.5'E, alt. 550 m, 14 xi. 1992, G. Kantvilas 532/92 (HO).

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TWO NEW SAXICOLOUS SPECIES OF THE LICHEN GENUS *BYSSOLOMA* FROM NEW ZEALAND

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ABSTRACT

Two new saxicolous species of *Byssoloma* from New Zealand are described and illustrated, and a key is provided for the five species known from that country.

INTRODUCTION

Byssoloma is a genus of crustose lichens which colonize mostly leaves but sometimes bark or rock (Galloway 1985). The name in Greek means "cottony hem" and refers to the cobwebby (byssoid) margins of the apothecia. The margins are composed of loose hyphae which grow out of the excipulum of the apothecium and lie on the surface of the thallus. The byssoid margins are not always obvious - in some species they are reduced or turned under, and therefore must be sectioned to be seen clearly (Kalb & Vězda 1990). Also, in some species they are dense rather than cobwebby, and hence are easily mistaken as lecanorine. However, unlike true lecanorine margins, they lack algal cells and a cortex, and are built of free rather than compressed hyphae. Often the hyphae are encrusted with crystals (Vězda & Kalb 1991) which are colourless and nearly invisible when viewed in bright field, but are strongly coloured and highly visible when viewed in polarized light.

Although byssoid margins are their most striking trait, all species of *Byssoloma* are also crustose and ecorticate, with a hymenium reacting I+ blue, simple or only sparingly branched paraphyses, thick-walled and eight-spored asci, and colourless and transseptate spores $9-30 \times 2.5-6.5 \mu\text{m}$. Their pycnidia are mostly sessile and globose, and their conidia simple and mostly pear-shaped. Their algal symbionts are species of the family Chlorococcaceae with globose cells $5-12 \mu\text{m}$ in diameter. Until recently, all known species of *Byssoloma* were thought to be nearly obligately foliicolous (Santesson 1952).

Introduced in Trevisan (1853), the name *Byssoloma* was displaced for seventy years by the illegitimate *Pilocarpon* and *Tricholechia* (Santesson 1952). On the basis of its ascus characters, it is now placed in the Pilocarpaceae (Zahlbruckner 1905 emend. Hafellner 1984) as a segregate of Lecideaceae s. lat. (Lecanorales). The

closely related genus *Fellhanera* Vězda (1986) differs in having an excipulum of continuous paraplectenchyma rather than byssoid hyphae, and also by *Mycobilimbia*-like ascospores.

Galloway (1985) lists two *Byssoloma* species, both of them foliicolous: *B. subdiscordans* (Nyl.) P. James (as *B. rotuliforme* (Müll. Arg.) R. Sant. ex Thorold) and *B. subundulatum* (Stirton) Vězda (as *Bacidia subundulata* (Stirton) R. Sant.). A third foliicolous species, *B. leucoblepharum* (Nyl.) Vainio, was reported recently by Galloway (1992). In this paper we describe two new saxicolous taxa and provide a key for all five species.

Byssoloma adpersum* Malcolm & Vězda *sp. nov.

Fig. 1

Thallus epilithinus rarius epixylinus, crustaceus, continuus, minute farinosus vel verrucosus, hebetatus vel nitidus. Prothallus aut fere nullus aut albidus vel atrovinidis. Apothecia orbicularia, 0.5-0.8 mm lata, 0.2-0.25 mm alta, basin versus arcte constricta, adnata, discis planis vel in aetate convexis, nigris, marginibus breviter albo-byssaceis, in aetate bysso excluso vel fere nullo. Excipulum tantum laterale evolutum, 40-50 μm latum, hyphis liberis contextum, intus hyphis radiantibus hypothecio atropurpureo confluentibus formatum. Hymenium 60-70 μm altum, zona epihymeniali fusca, ceterum hyalinum, granulis copiosis parvis adpersum. Paraphyses luminibus 1.5 μm crassis. Asci clavati, 8-sporei. Ascosporeae $\pm$ ellipsoideae, uno apice magis attenuato, transverse (3-)5 septatae, halonatae, 15-18 x 4.5 μm (sine halo).

Type. New Zealand, South Island, Nelson, Brook Stream track, 41°19'S, 173°17'E, NZMS 260 O-27:342875, on siliceous rocks in shaded lowland mixed *Nothofagus*-podocarp forest, alt. 160 m, 12 v. 1993, *W. Malcolm 800* (CHR470258). Isotypus: herbarium A. Vězda. Topotypus: Lichenes Rariores Exsiccati 201, Vězda.

Thallus epilithic or rarely lignicolous, crustose, minutely farinose to warty, matt to shiny. *Prothallus* absent or whitish to dark green. *Apothecia* orbicular, 0.5-0.8 mm wide, 0.2-0.25 mm tall, strongly constricted toward the base, adnate, disk plane or convex with age, black, margin narrowly white-byssoid, in age completely byssoid or nearly absent. *Excipulum* barely developed laterally, 40-50 μm wide, hyphae free, interwoven, the inner hyphae forming a dark-purple hypothecium. *Hymenium* 60-70 μm tall, epihymenial zone brown, otherwise hyaline, often with numerous scattered granules. *Paraphyses* with 1.5 μm wide lumen. *Asci* clavate, 8-spored. *Ascospores* more or less ellipsoid, one apex blunter than the other, transversely (3-)5-septate, halonate, 15-18 x 4.5 μm (without halo).

Habitat and distribution: Known from the upper third of the South Island on siliceous rocks (and rarely preservative-treated wood) in lowland habitats from shady mixed *Nothofagus*-podocarp forest.

Etymology. The epithet *adpersum* refers to the copious highly birefringent granules often seen in the hymenium.

Recognition. *B. adpersum* belongs to the group of species of *Byssoloma* with distinctly byssoid margins that lack scattered granular crystals. It is closely related to *B. subdiscordans*, but clearly differs in its typically 5-septate spores and its hymenium with copious granules. In many respects it resembles *B. octomerum* Malcolm & Vězda.

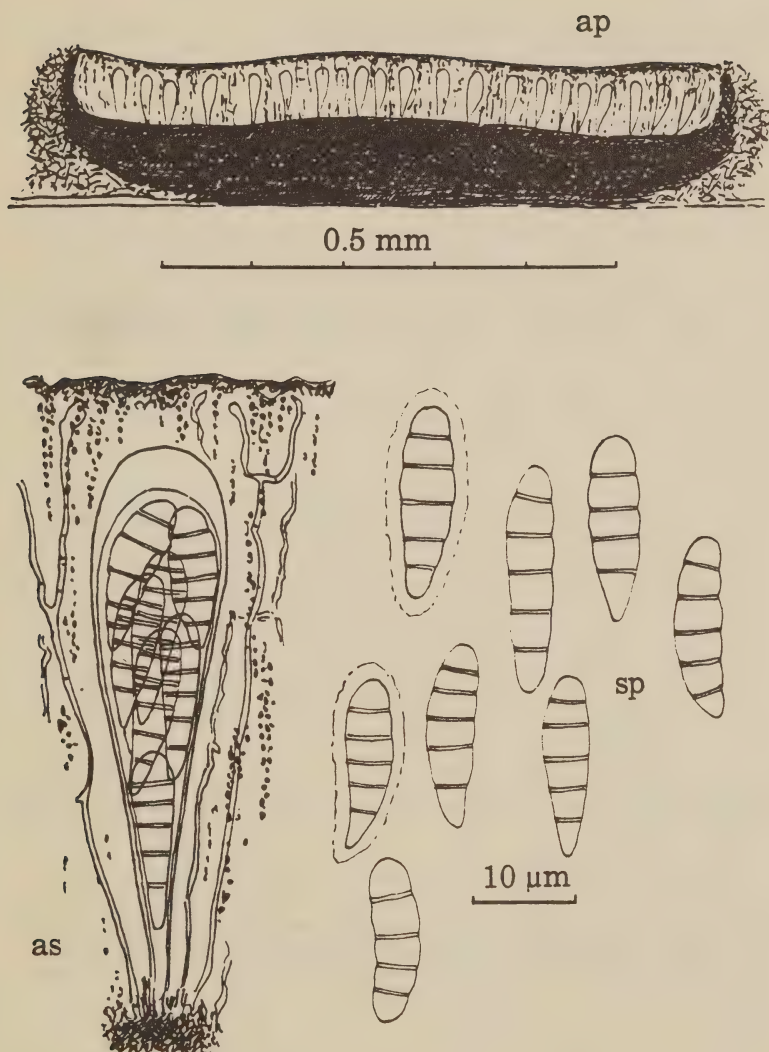


Figure 1. *Byssoloma adpersum* sp. nov. (Orig.) **ap** apothecium (vertical section), **as** ascus with paraphyses, **sp** ascospores (some with halo).

Byssoloma octomerum Malcolm & Vězda *sp. nov.*

Fig. 2

Thallus epilithinus, modice crassus, cinereo-olivaceus, continuus, rimoso-areolatus, areolis 0.5-0.7 mm diametro. Prothallus cinereoalbidus. Apothecia orbicularia vel ambitu lobulata vel aggregata et tum mutua pressione difformata, 0.75-1.0 mm diametro, 0.2-0.25 mm alta, partibus basalibus in thallo immersa, discis nigris, nudis, planis vel paulum convexis, marginibus byssaceis albidolivaceis, tenuibus, in aetate inclusis. Excipulum laterale tantum evolutum, circa 50 μ m latum, hyphis liberis hyalinis 2 μ m crassis contextum, crystallis nullis adpersis. Hypothecium rubrofusum, 100-150 μ m altum. Hymenium 70-75 μ m altum, granulis sparsis parvis adpersum, zona ephymeniali impure viridescens, ceterum hyalinum. Paraphyses tubulus, 1-1.5 μ m crassis. Asci cylindrico-clavati, 8-spori (vel ascosporis 4-6). Ascospores cylindricae, apicibus rotundatis, transverse (5-)7-septatae, ad septa constrictae, halonatae (22-)25-28(-30) $\times$ 4-4.5 μ m (sine halo).

Type. New Zealand, South Island, Nelson, Sharland Creek, 41°15.5'S, 173°20.5'E, NZMS 260 O-27:388943, on siliceous rock in lowland mixed *Nothofagus*-podocarp forest, alt. 160 m, 12 v. 1993, *W. Malcolm 851* (CHR413972).

Thallus epilithic, moderately thick, ashen grey-green, continuous, cracked-areolate, areolae 0.5-0.7 mm diameter. *Prothallus* ashen white. *Apothecia* orbicular, lobed or aggregated and deformed by mutual pressure, 0.75-1 mm, 0.2-0.5 mm tall, base partly immersed in the thallus, disk black, epruinose, plane to slightly convex, margin cobwebby, greyish white, thin, becoming enclosed with age. *Excipulum* barely developed laterally, about 50 μ m wide, hyphae free, hyaline, 2 μ m thick, interwoven, lacking scattered crystals. *Hypothecium* red-brown, 100-150 μ m tall. *Hymenium* 70-75 μ m tall, with sparse granules, ephymenial zone pale green, otherwise hyaline. *Paraphyses* tubular, 1-1.5 μ m thick. *Asci* cylindrical-clavate, (4-6)-8 spored. *Ascospores* cylindrical, with round apices, transversely (5-)7-septate, constricted at the septa, halonate, (22-)25-28(-30) $\times$ 4-4.5 μ m (without halo).

Habitat and distribution: Known only from shaded siliceous rocks in moist lowland *Nothofagus*-podocarp forest in the Nelson area, but probably more widely distributed in similar sites.

Etymology: The epithet *octomerum* refers to the 8-locular ascospores.

Recognition. *B. octomerum* is closely related to *B. adpersum* Malcolm & Vězda, but is distinguished from other species of the genus by its cylindrical, 7-septate spores which are distinctly constricted at the septa, and by the scarcity of granules in its hymenium.

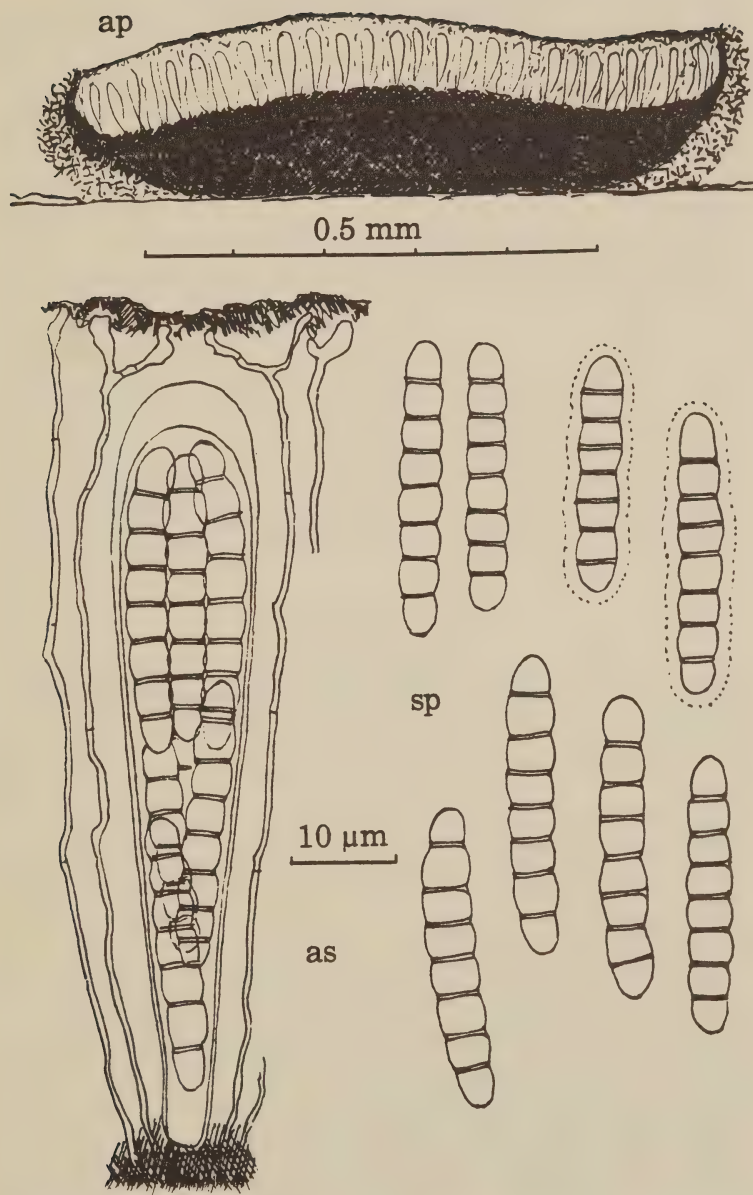


Figure 2. *Byssoloma octomerum* sp. nov. (Orig.) **ap** apothecium (vertical section, **as** ascus with paraphyses, **sp** ascospores (some with halo).

KEY TO THE SPECIES OF *BYSSOLOMA* IN NEW ZEALAND

1. Margins of apothecia clearly cottony or cobwebby (byssoid), and lacking copious scattered birefringent crystals which are colourless and nearly invisible when viewed in bright field but are strongly coloured and highly visible when viewed in polarized light.....2
1. Margins of apothecia byssoid but dense and thus appearing lecanorine, with copious scattered crystals which when dissolved out by KOH make the hyphae appear loose.....*Byssoloma subundulatum*
2. Follicolous, ascospores 3-septate, ellipsoid.....3
2. Saxicolous or rarely lignicolous, ascospores (3-)5-7-septate, long-ellipsoid.....4
3. Thallus white, more or less dispersed; apothecial disks black.....*Byssoloma subdiscordans*
3. Thallus never white, continuous; apothecial disks more or less brown.....*Byssoloma leucoblepharum*
4. Ascospores (3-)5(-7)-septate, not obviously constricted at the septa, ellipsoid, 15-20 x 4.5-6.5 μm , hymenium usually with scattered granules.....*Byssoloma adpersum*
4. Ascospores (5-)7-septate, distinctly constricted at the septa, cylindrical, (23-)25(-30) x 4-4.5 μm , hymenium without granules.....*Byssoloma octomerum*

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LICHENICOLOUS FUNGI FROM THE IBERIAN PENINSULA AND THE CANARY ISLANDS 1

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ABSTRACT: An annotated list of 35 lichenicolous fungi from the Iberian Peninsula and the Canary Islands is presented. The list includes 21 ascomycete and 14 conidial fungi. A new species growing on *Diploicia canescens*, *Arthonia diploiciae* Calatayud & Diederich sp. nov. is described. Six species are reported for the first time from Spain and one is new to the Iberian Peninsula. New host species are given for *Arthonia molendoi*, *Lichenodiplis lichenicola* and *Phoma cytospora*.

KEYWORDS: Lichenicolous fungi, lichens, ascomycetes, coelomycetes, hyphomycetes, Spain, Canary Islands, *Arthonia*.

INTRODUCTION

Since some lichenicolous fungi were included by Vouaux in "Contribution a l'étude des lichens de les iles Canaries" (PITARD & HARDMAN, 1912), and the reports from northern Spain made by SANTESSON (1960) and KILIAS (1978), our knowledge of the lichen-inhabiting fungi from Spain has increased rapidly. Most of the records are, however, scattered. Lichenicolous fungi are mainly mentioned as a complement of regional catalogues of lichens (e.g. BOQUERAS & GOMEZ-BOLEA, 1986; ALVAREZ & CARBALLAL, 1987; ETAYO, 1988, 1994; CALATAYUD &

BARRENO, 1994), as material examined in wider studies (e.g. HAFELLNER, 1979; HAWKSWORTH, 1981; NAVARRO-ROSINES & HLADUN, 1990) or as descriptions of new species or genera (e.g. NAVARRO-ROSINES & HAFELLNER, 1993; HAFELLNER & NAVARRO-ROSINES, 1993). Recently, a few more comprehensive lists of lichenicolous fungi have been published (NAVARRO-ROSINES & HLADUN, 1987; HAFELLNER & SANCHO, 1990 and GIRALT & GOMEZ-BOLEA, 1988). These kinds of contributions are very valuable for the planned Spanish lichen flora, where lichenicolous fungi should also be considered. Many new and interesting finds are expected, in view of the great ecological and climatic diversity of this territory (including also the Canary Islands). This paper is our first contribution of a series dealing with lichenicolous fungi. The samples have been collected on saxicolous, terricolous and epiphytic lichens, in different parts of the Iberian Peninsula and Canary Islands, the eastern Spanish territories being the best represented.

We wish to express our gratitude to Prof. D.L. Hawksworth (Egham), for encouraging us to prepare this paper, for correcting the English text and for valuable discussions on the manuscript. Also to Dr P. Diederich (Luxembourg), for critical reading the manuscript, for identification of several specimens, and for offering us to include here several samples collected by him, together with J. Etayo, in Spain. Dr D. Triebel (Munich) is thanked for checking several *Endococcus* specimens. We are also indebted to our colleagues of the lichenological and bryological teams of the University of València, and to Drs B. Aguirre-Hudson, J. Etayo, V.J. Rico and A. Raga for help in various ways. This study has been supported with funds of the DGICYT, project PB89-0415.

MATERIAL AND METHODS

Macroscopic features were examined with a Zeiss Stemi SR dissecting microscope. Microscopic characters were studied in squash preparations or in 10-20 µm sections mounted in water, 10% KOH (K), Lugol's iodine solution, erythrosin or lactophenol cotton-blue, using a Olympus BH-2 light microscope and a Nikon Optiphot-2, fitted with Nomarski differential interference contrast. Nomenclature mostly follows HAWKSWORTH (1979, 1981, 1983), CLAUZADE *et al.* (1989) and ALSTRUP & HAWKSWORTH (1990) for lichenicolous fungi, and PURVIS *et al.* (1992) and NIMIS (1993) for host species. The material examined is deposited in VAB-lich. herbarium and in P. Diederich private herbarium (herb. Diederich, Luxembourg); a few duplicate specimens are preserved in IMI.

THE SPECIES

Abrothallus acetabuli Diederich

This recently described species (DIEDERICH, 1990: 298) is distinguished from other *Abrothallus* species occurring on *Parmelia* sens. lat. by the hymenium not reacting in K, the epithecium K+ yellow, the rather large apothecia (to 0.5 mm in the material examined) and by the dimensions of the ascospores (14-16 x 5-7 μ m) and conidia (7-8 x 4-5 μ m). *Abrothallus acetabuli* is so far restricted to *Parmelia acetabulum* and does not produce malformations on its thallus. A previous citation of *Abrothallus parmeliarum* on *Parmelia acetabulum* from Catalonia (GOMEZ-BOLEA, 1985), probably refers to this species. *Abrothallus acetabuli* is known from France, Germany, Luxembourg, perhaps the Netherlands (DIEDERICH, op. cit.), and Spain.

Specimens: SPAIN, Castelló: Fredes, Pinar Pla, UTM: 30TBF6109, on *Pinus sylvestris* L., (on *Parmelia acetabulum*), 1200 m, 12.X.1992, V. Calatayud, E. Barreno et al., VAB-lich. 2494. - Navarra: 'Lesavis' ?, on *Quercus robur* L. / *Q. petraea* (Matt.) Liebl., (on *Parmelia acetabulum*), 850 m, 17.IV.1992, J. Etayo, herb. Diederich.

Abrothallus parmeliarum (Sommerf.) Arnold

This widely distributed lichenicolous fungus has been collected on *Parmelia saxatilis*, *P. tinctoria* and *P. lusitana*, inducing deformations in the thalli of these lichens. It could be mistaken for *Abrothallus bertianus*, but typical specimens of that species never form cecidia or deformations in the host lichen (SANTESSON, 1960: 514), have smaller ascospores (HAWKSWORTH & MINTER, 1980: 587; ALSTRUP & HAWKSWORTH, 1990: 15), and the vegetative hyphae are I+ blue. *A. parmeliarum* has been reported on many *Parmelia* species and also on *Platismatia glauca* (SANTESSON, 1993: 7) but, in our opinion, it might be an heterogeneous taxon. The specimens we examined on species of *Parmelia* subgenus *Xanthoparmelia* differ from those on *P. saxatilis*, the host species on which this lichenicolous fungus was described, by the intense K+ green reaction in all parts of the hymenium, including the lower part. At the moment, we consider these specimens within the variability of *A. parmeliarum*, but a further taxonomical study with additional material would be required to decide whether such specimens could be separated in a different taxon. The identity of *Abrothallus caeruleus* Kotte, a neglected species described on a *Parmelia* subgenus *Xanthoparmelia*, should be also investigated in order to have a more conclusive opinion on this subject (Diederich, in litt.).

Specimens: SPAIN, Castelló: Almedijar, UTM: 30SYK2217, roca silícea cubierta de suelo, (on *Parmelia lusitana*), 500 m, 21.I.1993, V. Calatayud, VAB-lich. 2577. -

Castelló: Ahín, Pico Batalla, UTM: 30SYK2717, arenisca, (on *Parmelia tinctoria*), 860 m, 20.I.1990, V. Calatayud, VAB-lich. 1805. - Navarra: W Pamplona, Sierra de Urbasa, Pto. de Urbasa, on *Fagus* L., (on *Parmelia saxatilis*), 20.VII.1991, P. Diederich & J. Etayo, herb. Diederich 9649. - Teruel: Noguera, puerto de Noguera, UTM: 30TXK18, arenisca, (on *Parmelia saxatilis*), 23.XI.1993, V. Calatayud, E. Calvo & M. J. Sanz, VAB-lich. 7488. - Tenerife: Buenavista del Norte, Los Carrizales, UTM: 28RCS1836, roca volcanica, (on *Parmelia lusitana*), 520 m, 2.IV.1992, E. Barreno, V. Calatayud et al., VAB-lich. 7471.

***Arthonia diploiciae* Calatayud & Diederich sp. nov.**

(Fig. 1)

Arthonia epiphyscia similis est, a qua differt pseudotheciis ascosporisque minoribus et ascis 4-sporis. Crescit in thallo *Diploiciae canescentis*.

Typus: SPAIN, Almería, Campo de Dalias, Punta del Sabinal, UTM: 30SWF2260 on *Juniperus phoenicea* subsp. *turbinata* (Gus.) Nyman, on *Diploicia canescens*, 10 m, 16.III.1993, E. Barreno, V. Calatayud & M. J. Sanz, (VAB-lich. 7547, holotypus; IMI 362752 isotypus).

Description: *Ascomata*: very numerous, arthonioid, black, sessile, convex, 70-130 µm diam., producing more or less circular, pale brown infection spots on the surface of the host lichen. *Hymenium*: hyaline to pale brown, 25-35 µm tall, I+ red, KI+ blue. *Epithymenium*: brown, K-, N-. *Hypothecium*: pale brown to brown, 25-35 µm tall. *Hamathecium*: of paraphysoids, 2-3 µm wide, branched and anastomosed, septate, thickened at the apices, which are 4-5 µm thick. *Asci*: clavate to subglobose, 4-spored, apical part thickened, with the ocular chamber surrounded by an amyloid ring (observed in Lugol's solution after K), *Arthonia*-type, 15-22 x 7-12 µm. *Ascospores*: 1-septate, lower cell slightly attenuated, apices rounded, hyaline, smooth-walled, 8-11(-12) x 3,5-4(-5) µm. Host: *Diploicia canescens* (Dickson) Massal.

Arthonia diploiciae is easily distinguished from other *Arthonia* species by the very small ascomata, arising in groups of up to 125, inducing brown spots in the thallus of the host, by the 4-spored asci, the size of the ascospores, and by its occurrence on *Diploicia canescens*. It is close to *Arthonia epiphyscia*, from which it differs in the much smaller ascomata, and especially the 4-spored asci. This is also a relevant character for its separation from other lichenicolous *Arthonia* reported on lichens of genera in the *Physciaceae*, such as *A. epimela* (SANTESON, 1993: 16) or the recently described *A. aggregata* (ALSTRUP, 1993: 96-97). *A. diploiciae* must be considered as pathogenic, since those parts of the lichen thallus infected are partially destroyed.

This new species is only known from Spain and Portugal, but some specimens of an unidentified *Arthonia* on *Diploicia canescens* reported from Sardinia (NIMIS & POELT, 1987: 40) could be conspecific. Another collection of an *Arthonia* similar to *Arthonia clemens* growing on *Diploicia canescens* mentioned by PURVIS *et al.* (1992: 79) from Great Britain should also be restudied.

Additional specimens: PORTUGAL, Algarve: NW of Sagres, S of road to Cabo de São Vicente, halfway, coastal plain with exposed outcrops and shrubs, on a shrub, alt. 50 m, coord. 8°59.2'W, 37°01.4'N, (on *Diploicia canescens*), 22.VII.1993, Pieter van den Boom, herb. van den Boom, herb. Diederich 14582. - SPAIN, Mallorca: Ca'n Picafort, on *Pinus halepensis* Miller, on the shore, (on *Diploicia canescens*), 27.IV.1987, W.O. Knoop, herb. A. Aptroot., herb. Diederich.

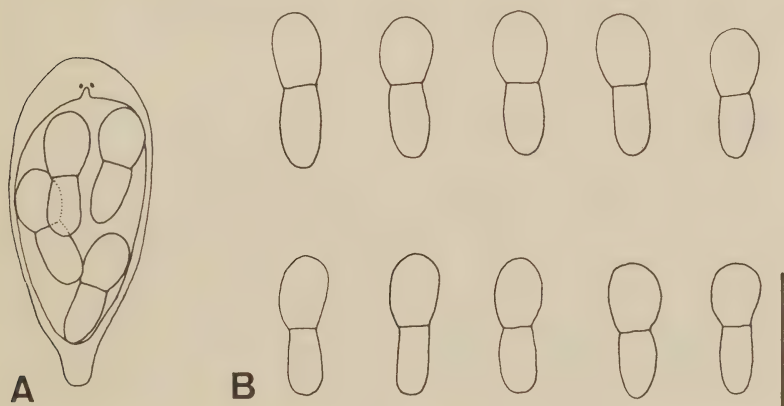


Fig. 1. *Arthonia diploiciae* (holotype, VAB-lich. 7294). A, Mature ascus with Lugol's iodine after KOH. B, Ascospore outlines. Scale bar = 10 µm.

***Arthonia epiphyscia* Nyl.**

Arthonia epiphyscia is characterized by having slightly aggregate ascomata, up to 0.2 mm diam., hymenium I+ red, KI+ blue, hypothecium dark brown, asci 8-spored and ascospores 8-13 x 4-5 µm, 1-septate, lower cell narrower and longer than the upper. This lichenicolous fungus has been reported on several host species, mainly of the genera *Physcia*, *Phaeophyscia*, and *Xanthoria* (CLAUZADE *et al.*, 1989: 29), but also on *Caloplaca saxicola* and on *Phaeorrhiza nimbosa* (ALSTRUP & HAWKSWORTH, 1990: 16). However, SANTESSON (1993: 16) consider

that *A. epiphyscia* is restricted to species of the genera *Physcia* and *Phaeophyscia*. DIEDERICH (in litt.) agrees with Santesson's opinion and suggests that specimens of *A. epiphyscia* reported as growing on *Caloplaca* or *Xanthoria* ssp. might belong to *A. molendoi*. We have examined samples of the *A. epiphyscia* complex on *Caloplaca aurantica*, *Physcia stellaris* and *Xanthoria parietina*, and certainly, those occurring on *Physcia stellaris* have a darker hypothecium than those on *Xanthoria* and *Caloplaca*. Consistently, following the above mentioned criterion, the first ones clearly belong to *A. epiphyscia* sens. strict., and the second ones are treated under *A. molendoi*. In a wide sense, *A. epiphyscia* is a cosmopolitan species, probably common in the Iberian Peninsula, where it is locally abundant in nutrient-rich habitats.

Specimen: SPAIN, València: Puebla de San Miguel, La Canaleja, UTM: 30TXK6037, on *Juniperus thurifera* L., (on *Physcia stellaris*), 1440 m, 1.VII.1993, V. Calatayud, V. Atienza & S. Fos, VAB-lich. 7307.

Arthonia glaucomaria Nyl.

Arthonia glaucomaria has been reported mainly covering the apothecia of species of the *Lecanora rupicola* group, which become black (LEUCKERT & POELT, 1989: 128). One of us (V.C.) examined specimens both on *Lecanora rupicola* and on other *Lecanora* species (*L. muralis* and *L. dispersa* sens. lat.) and no significant morphological differences have been observed. In our opinion, *A. glaucomaria* is probably a very common lichenicolous fungus, occurring on a wide range of *Lecanora* species. In two of the specimens (VAB-lich. 7490 and VAB-lich. 2477), we observed conidiomata, which produce bacilliform, 4-6 x 1 µm conidia. *A. glaucomaria* has been reported previously from Spain several times, e.g.: by NAVARRO-ROSINES & HLADUN (1990: 78) on *Lecanora marginata*, by HAFELLNER & SANCHO (1990: 364) on *Lecanora rupicola*, and from the Canary Islands by HAWKSWORTH (1982b: 83) on *Lecanora rupicola* coll.

Specimens: SPAIN, Castelló: Morella, El Campello, UTM: 30TYK4490, roca caliza, (on *Lecanora muralis* v. *versicolor*), 1000 m, 10.X.1992, V. Calatayud, E. Barreno et al., VAB-lich. 2477. - Castelló: Todolella, UTM: 30TYL2902, roca caliza, (on *Lecanora muralis* v. *versicolor*), 800 m, 12.X.1992, V. Calatayud, E. Barreno et al., VAB-lich. 2486. - Castelló: Chovar, Port d'Eslida, UTM: 30SYK2916, arenisca, (on *Lecanora polytropa*), 580 m, 6.VII.1991, V. Calatayud, VAB-lich. 1971. - Cuenca: Talayuelas, Pico Ranera, UTM: 30SXX4408, arenisca, (on *Lecanora dispersa* sens. lat.), 1400 m, 18.VII.1992, V. Calatayud, VAB-lich. 7489. - La Palma: entre Corralejos y Punta Roque, roca volcánica, (on *Lecanora rupicola*), 2000 m, 20.XI.1993, E. Barreno & A. Santos, VAB-lich. 7527. - Tenerife: Parque Nacional de El Teide, Roques de García, rocas volcánicas, (sobre *Lecanora rupicola*), 2125 m, 23.IX.1993, V. Calatayud, VAB-lich. 7490.

Arthonia molendoi (Frauenfeld) R. Sant.

This species is very close to *A. epiphyscia*, but differs in having a paler hypothecium. *A. molendoi* has previously been reported on *Physcia*, *Phaeophyscia* and *Caloplaca* species, but according to SANTESSON (1993: 17), it grows only on *Caloplaca* and *Xanthoria* spp. We have found it on *Xanthoria parietina* and on *Caloplaca aurantica*, which is a new host species.

Specimens: SPAIN, Castelló: Forcall, ermita S. Cristòfol, UTM: 30TYL3500, roca caliza, (on *Caloplaca aurantica*), 1100 m, 18.XII.1993, V. Calatayud, VAB-lich. 7543. - València: Puebla de San Miguel, La Canaleja, UTM: 30TXK6037, on *Juniperus thurifera* L., (on *Xanthoria parietina*), 1440 m, 1.VII.1993, V. Calatayud, V. Atienza & S. Fos, VAB-lich. 7306.

Bispora christiansenii D. Hawksw.

This is a widespread lichenicolous hyphomycete, known on a wide range of crustose and fruticose lichens (HAWKSWORTH, 1979: 208-209; ALSTRUP & HAWKSWORTH, 1990: 19). It was collected by us on a *Lecanora* species and on *Caloplaca aurantia*. Widespread in Europe and previously reported from Spain by DIEDERICH (1986: 17-18) and GIRALT & GOMEZ-BOLEA (1988: 198).

Specimens: SPAIN, Teruel: Cedrillas, nacimiento del río Mijares, on *Pinus sylvestris* L., (on *Lecanora* sp.), 21.V.1993, 1500 m, V. Atienza, & S. Fos, VAB-lich. 5217. - Castelló: Coratxà, UTM: 30TBF5308, roca caliza, (on *Caloplaca aurantia*), 1200 m, 6.X.1994, V. Calatayud, & E. Calvo, VAB-lich. 7563.

Buellia badia (Fr.) Massal.

Buellia badia begins its life-cycle as a parasite of several lichens (mainly brown *Parmelia* species, but also on other saxicolous lichens) and later develops its own thallus and becomes independent. However, some specimens seem to be independent from the beginning (VAB-lich. 7132, 7404). *Buellia badia* has a worldwide distribution and is also a common species in Spain.

Specimens: SPAIN, Castelló: Artana, Peñas Aragonesas, UTM: 30SYK3522, arenisca, (on *Dimelaena oreina*), 320 m, 17.IV.1993, V. Calatayud, VAB-lich. 7166. - Castelló: Chovar, Bco. Carbón, UTM: 30SYK2915, arenisca, (on *Parmelia pulla*), 415 m, 29.IX.1989, V. Calatayud, VAB-lich. 1728. - Castelló: Chovar, Pico Terraguán, UTM: 30SYK3016, arenisca, on an unidentified sterile crustose lichen thallus, 620 m, 12.II.1990, V. Calatayud, VAB-lich. 1962. - Castelló: Pobla Tornesa, Marmudella, UTM: 30SYK4644, arenisca, 450 m, 6.IX.1993, V. Calatayud, VAB-lich. 7408. -

Castelló: Vilafamés, San Miguel, UTM: 30SYK4840, arenisca, (on *Parmelia pulla*), 500m, 6.IX.1993, V. Calatayud, VAB-lich. 7342. - Valencia: Benifairó, UTM: 30SYK3201, arenisca, 250 m, 16.IV.1993, V. Calatayud, VAB-lich. 7132. - Valencia: Gilet, Sancti Spiritu, UTM: 30SYJ2795, arenisca, (margin of *Dimelaena oreina*), 300 m, 15.IV.1993, V. Calatayud, VAB-lich. 2987. - Valencia: Puçol, El Picaio, UTM: 30SYJ3091, arenisca, (on *Parmelia verruculifera*), 350 m, 26.II.1992, V. Calatayud, VAB-lich. 2590.

Cornutispora lichenicola D. Hawksw. & B. Sutton

Conidiomata of this coelomycete, with characteristic Y-shaped conidia, were found growing on *Pseudevernia furfuracea* and *Lobaria pulmonaria* sens. lat. Previously reported from Spain by DIEDERICH (1986: 19) and GIRALT & GOMEZ-BOLEA (1988: 196). It is widespread in Europe.

Specimens: SPAIN, Navarra: Au nord-ouest de Isaba, près de la route au nord-ouest de Uztárroz, on *Fagus* L., dans une hêtraie, (on *Lobaria pulmonaria*), 20.VII.1990, P. Diederich, herb. Diederich. - Teruel: Cedrillas, nacimiento del río Mijares, on *Pinus sylvestris* L., (on *Pseudevernia furfuracea*), 1500 m, 21.V.1993, V. Atienza & S. Fos, VAB-lich. 5312.

Corticifraga peltigerae (Fuckel) D. Hawksw. & R. Sant.

Infection by this species first produces decolourized patches and later necrosis on thalli of several species of *Peltigera*, and very rarely on *Solorina crocea*. The collection studied was on *P. canina* and all the characters agree well with the description of HAWKSWORTH & SANTESSON (1990: 130). The distributional range of *Corticifraga peltigerae* includes Europe, the Canary Islands, S. America and Greenland. HAWKSWORTH & SANTESSON (1990: 132) reported this species from the Canary Island and northern Spain (Asturias).

Specimen: SPAIN, Castelló: Pina de Montalgrao, Sta. Barbara, UTM: 30SYK0233, arenisca, (on *Peltigera canina*), 1300 m, 21.III.1992, V. Calatayud, VAB-lich. 7487.

Endococcus parietinarius (Lindsay) Clauzade & Roux

The ascomata of this species cover both the apothecia and, less frequently, the thalli of *Xanthoria parietina*, producing slight discolouration and deformation. Their characters fit with the description given by HAWKSWORTH (1982: 382-383) in the absence of a paraphysoid net and asci with 8 ascospores irregularly arranged. Widely distributed in Europe and reported here for the first time from Spain.

Specimen: SPAIN, Soria: Calatañazor, UTM: 30TWM1516, on *Juniperus thurifera* L. (on *Xanthoria parietina*), 1015 m, 29.VI.1992, E. Calvo, VAB-lich. 9222.

Endococcus rugulosus Nyl.

The specimens of *Endococcus rugulosus* cited below were on an unidentified *Aspicilia* and their characters fit the descriptions by HAWKSWORTH (1979: 287) and TRIEBEL (1989: 103-105) well, except in the occurrence of a hyaline, ca. 20 µm thick outer layer, surrounding the pseudothecia. This layer is formed by roundish, thick-walled cells 3-5 µm wide. A similar structure has also been observed by one of us (V.C.) in several species of *Cercidospora* and, according to Triebel (in litt.), it occurs from time to time in other lichenicolous fungi. In spite of being very conspicuous, in our opinion this is not a relevant character from a taxonomic point of view, since it seems to be a variable reaction produced by the host. As in other samples from Spain examined by HAFELLNER & SANCHO (1990: 369), the specimens examined occurred on *Aspicilia* sp., but this fungus is known on a wide range of crustose lichens, especially ones growing on siliceous rocks, and has a worldwide distribution. The sample VAB-lich. 7150 has been checked by D. Triebel.

Specimens: SPAIN, Cuenca: Talayuelas, Pico Ranera, UTM: 30SXK4408, conglomerado silíceo, (on *Aspicilia* sp.), 1200 m, 16.II.1993, V. Calatayud & V. J. Rico, VAB-lich. 7298. - *Ibid.*, (on *Aspicilia* sp.), 18.VII.1992, V. Calatayud, VAB-lich. 7150.

Libertiella malmedyensis Speg. & Roum.

The specimen we examined has slightly shorter conidia, only 4-6 µm long, than the measures mentioned by HAWKSWORTH (1981: 31), (5-)6-8 µm long; the other characters agree well with the description of that author. The fungus was on *Peltigera* sp., sometimes growing on damaged zones, but it is not clear if the injuries to the host thallus were produced by this fungus or not. Colonies of green algae were also found mixed with the coniomata of *L. malmedyensis*, but we did not observe contact between the fungal hyphae and the algal cells. *Libertiella malmedyensis* is known from Europe, this citation being the first from Spain.

Specimen: SPAIN, València: Serra, El Garbí, UTM: 30SYJ2597, arenisca, (on *Peltigera* sp.), 575 m, 16.II.1993, V. Calatayud & V. J. Rico, VAB-lich. 2850.

Lichenocodium erodens M.S. Christ. & D. Hawksw.

The material of this coelomycete examined occurred on *Parmelia saxatilis*, but it is also known on other foliose, fruticose and crustose lichens. It is a wide-ranging species, previously reported from Spain in GIRALT & GOMEZ-BOLEA (1988: 196).

Specimen: SPAIN, Teruel: Cedrillas, nacimiento del río Mijares, on *Pinus sylvestris* L., (on *Parmelia saxatilis*), 1700 m, 21 V.1993, V. Atienza & S. Fos, VAB-lich. 5223.

Lichenocodium lecanorae (Jaap) D. Hawksw.

Another common and widespread lichen-inhabiting fungus, collected by us on *Lecanora* and *Caloplaca* species, but occurring on a wide range of lichens. *Lichenocodium lecanorae* is known from Europe and the U.S.A. and has been previously reported from Spain in SANTESSON (1960: 519, sub *Lichenocodium lecanoraceum* (Vouaux) Petrak & H. Sydow) and in GIRALT & GOMEZ-BOLEA (1988: 197).

Specimens: SPAIN, Almería: Campo de Dalias, Punta del Sabinal, UTM: 30SWF2260 on *Pistacia lentiscus* L., (on *Caloplaca holocarpa*), 10 m, 16.III.1993, E. Barreno, V. Calatayud & M. J. Sanz, VAB-lich. 7491. - Teruel: Valdelinares, Puerto de Valdelinares, on *Pinus sylvestris* L., (on *Lecanora carpinea*), 1800 m, 9.VI.1993, V. Atienza, VAB-lich. 5219. - València: Rincón de Ademuz, Puebla de San Miguel, La Saladilla, Cerro Calderón, on *Pinus sylvestris* L., (on *Lecanora chlorotera*), 1700 m, 1.VII.1993, V. Atienza, S. Fos & V. Calatayud, VAB-lich. 5218.

Lichenocodium pyxidatae (Oudem.) Petrak & H. Sydow

Lichenocodium pyxidatae occurs on species of the genus *Cladonia* (including *Cladina*). It is known from Europe and N. America.

Specimens: SPAIN, Teruel: Cedrillas, nacimiento del río Mijares, on *Pinus sylvestris* L., (on *Cladonia pyxidata*), 1500 m, 21 V.1993, V. Atienza & S. Fos, VAB-lich. 5220. - València: Rincón de Ademuz, Puebla de San Miguel, La Saladilla, Cerro Calderón, on *Pinus sylvestris* L., (on *Cladonia ramulosa*), 1700 m, 1.VII.1993, V. Atienza, S. Fos & V. Calatayud, VAB-lich. 5221.

Lichenodiplis lecanorae (Vouaux) Dyko & D. Hawksw.

This coelomycete species has been found growing on *Caloplaca* species and on *Imshaugia*. It is a widespread lichenicolous fungi, known on a wide range of lichens (HAWKSWORTH, 1981: 38), and reported several times from Spain (e.g. SANTESSON, 1960: 520, sub *Ascochyula lecanorae*

(Vouaux) Keissler; HAWKSWORTH & DYKO, 1979: 52; BOQUERAS & GOMEZ-BOLEA, 1986: 67; GIRALT & GOMEZ-BOLEA, 1988: 197). *Lichenodiplis lecanorae* has been cited from Europe, Greenland, N. Africa, Canary Islands, N. America and S. America.

Specimens: SPAIN, Teruel: Cedrillas, nacimiento del río Mijares, on *Pinus sylvestris* L., (on *Imshaugia aleurites*), 1500 m, 21.V.1993, V. Atienza & S. Fos, VAB-lich. 5224. - Teruel: Valdelinares, Puerto de Valdelinares, on *Pinus sylvestris* L., (on *Caloplaca holocarpa*), 1800 m, 9.VI.1993, V. Atienza, VAB-lich. 5226. - València: Serra, El Garbí, UTM: 30SYJ2597, arenisca, (on *Caloplaca aetnensis*), 575 m, 10.VIII.1992, V. Calatayud, VAB-lich. 7467. - València: Rincón de Ademuz, Puebla de San Miguel, La Canaleja, on *Juniperus communis* L., (on *Caloplaca holocarpa*), 1440 m, 1.VII.1993, V. Atienza, S. Fos & V. Calatayud, VAB-lich. 5227.

Lichenodiplis lichenicola (Dyko) D. Hawksw.

This lichenicolous coelomycete is readily separated from the previous species by the size of both the conidiomata and the conidia. In the specimen studied, the conidiomata measured 70 µm diam., and the conidia 9-14 x 3-5 µm. *Pseudevernia* is a new host genus for this fungus, formerly known only on *Rinodina* (HAWKSWORTH & DYKO, 1979: 52; KALB & HAFELLNER, 1992: 70-71). We do not know of any previous reports of this species from Spain.

Specimen: SPAIN, Teruel: Cedrillas, nacimiento del río Mijares, on *Pinus sylvestris* L., (on *Pseudevernia furfuracea*), 1500 m, 21.V.1993, V. Atienza & S. Fos, VAB-lich. 5225.

Lichenostigma rugosa Thor

DIEDERICH (1986: 7-9) suggests that this species sometimes becomes lichenized, but this feature has never been observed in the material examined. *Lichenostigma rugosa* is known on several species of *Diploschistes* and its distribution range includes Europe, Greenland, Asia Minor, N. Africa and the U.S.A. Specimens from northern Spain have been distributed by SANTESSON (1986: 4).

Specimen: SPAIN, Castelló: Almenara, La Frontera, UTM: 30SYK3405, arenisca, (on *Diploschistes euganeus*), 230 m, 16.IV.1993, V. Calatayud, VAB-lich. 7237.

Marchandiomyces corallinus (Roberge) Diederich & D. Hawksw.

The genus *Marchandiomyces* was recently described by Diederich & Hawksworth (DIEDERICH, 1990: 312-314) to accommodate the hyphomycete previously known as *Illosporium corallinum* Roberge. The

material studied was on *Physcia* sp. *Marchandiomyces corallinus* is known from Europe and N. America, including Spain (ALVAREZ & CARBALLAL, 1987).

Specimens: SPAIN, Teruel: alrededores de Peralejos de las Truchas, *Quercus faginea* Lam., (on *Physcia semipinnata*), 1200 m, 25.I.1992, V. Calatayud & E. Barreno, VAB-lich. 7235. - *Ibid.*, (on *Physcia* sp.), X.1993, V. Calatayud, VAB-lich. 7500.

"*Melaspilea*" canariensis D. Hawksw.

As Hawksworth mentioned in PURVIS *et al.* (1992: 367), "the genus *Melaspilea* is heterogeneous and badly in need of a modern revision. The generally accepted type species, *Melaspilea arthonioides* (Fée) Nyl. appears to be close to *Buellia*". "*Melaspilea*" *canariensis* is a commensal on *Pertusaria*, previously reported as "*Karschia*" *talcofila* var. *irregularis* (HAFELLNER, 1979: 212; NIMIS & POELT, 1987: 108; CLAUZADE *et al.*, 1989: 49). One of us (V.C.) examined the holotype of *Melaspilea canariensis* and found that the hymenium has no reaction with Lugol's iodine (HAWKSWORTH, 1982b: 84), but turns blue when using this reagent after K. This lichenicolous fungus was previously known from the Canary Islands, where it seems to be frequent (VOUAUX, in PITARD & HARDMAN, 1912: 69; KALB & HAFELLNER, 1992: 72), and it is reported here for the first time from the Iberian Peninsula. The samples were collected on *Pertusaria gallica*, growing on volcanic rocks in the Gata Cape coast (Almería, southeastern Spain). It is noteworthy that the typical Mediterranean - Macaronesic distribution of this fungus is similar to that of some species of lichens such as *Ramalina requienii*, *Dimelaena radiata* or *Caloplaca glorieae* (LLIMONA & WERNER, 1975: 16, 26; CALATAYUD & BARRENO, 1994: 38). Previously reported from Sardinia, Madeira, and the Canary Islands.

Specimen: SPAIN, Almería: San José, Playa de Monsul, UTM: 30SWF7565, roca volcánica, (on *Pertusaria gallica*), 15 m, 15.III.1993, E. Barreno, V. Calatayud & M. J. Sanz, VAB-lich. 7465.

***Muellerella lichenicola* (Sommerf.) D. Hawksw.**

SANTESSON (1960: 507) and KILIAS (1978: 124) reported this species from northern Spain on *Caloplaca* sp., sub *Tichothecium lichenicola* (Sommerf.) R. Sant., and NAVARRO-ROSINES & HLADUN (1990: 80) on *Lecanora meolansii*. It is widely distributed in Europe.

Specimens: SPAIN, Teruel: Valdelinares, Puerto de Valdelinares, on *Pinus sylvestris* L., (on *Caloplaca* sp.), 1800 m, 9.VI.1993, V. Atienza, VAB-lich. 5236.

Muellerella pygmaea (Körber) D. Hawksw.

A very common and widely distributed species, collected by us on *Lecidea fuscoatra*, *Lecidea lapicida*, *Lecidella stigmatea*, *Rinodina cana*, *Tephromela atra*, and *Acarospora (Phaeothallus) sp.*

Specimens: SPAIN: Castelló: Almenara, La Frontera, UTM: 30SYK3405, arenisca, (on *Caloplaca subpallida*), 230 m, 16.IV.1993, V. Calatayud, VAB-lich. 7466. - Cuenca: Talayuelas, Pico Ranera, UTM: 30SXX4408, arenisca, (on *Rhizocarpon geographicum*), 1400 m, 18.VII.1992, V. Calatayud, VAB-lich. 7469. - Castelló: Coratxà, UTM: 30TBF5308, roca caliza, (on *Lecidella stigmatea*), 1200 m, 6.X.1994, V. Calatayud, & E. Calvo, VAB-lich. 7564. - Cuenca: Talayuelas, Pico Ranera, UTM: 30SXX4408, arenisca, (on *Lecidea fuscoatra*), 1200 m, 16.II.1993, V. Calatayud & V. J. Rico, VAB-lich. 2847. - Cuenca: Talayuelas, Pico Ranera, UTM: 30SXX4408, conglomerado silíceo, (on *Tephromela atra*), 1200 m, 16.II.1993, V. Calatayud & V. J. Rico, VAB-lich. 7299. - València: Puçol, El Picaio, UTM: 30SYJ3091, arenisca, (on *Rinodina cana*), 350 m, 16.VII.1990, V. Calatayud, VAB-lich. 7468. - València: Serra, El Garbí, UTM: 30SYJ2597, arenisca, (on *Dimelaena oreina*, 575 m, 18.X.1992, V. Calatayud, VAB-lich. 7470. - València: Torres Torres, UTM: 30SYK2602, arenisca, (on *Aspicilia contorta*), 250 m, 17.IV.1993, V. Calatayud, VAB-lich. 7117.

Nesolechia oxyspora (Tul.) Massal.

Nesolechia is close to *Phacopsis* Tul. in ascus and paraphyses types (TRIEBEL & RAMBOLD, 1988: 296), but differs in having semi-immersed ascomata, the development of the infections and the ascospore shape (ALSTRUP & HAWKSWORTH, 1990: 49). This cecidogenous (i.e. gall-inducing) species has been collected by us on *Parmelia* sens. lat. species, but occurs on a wide range of genera in the *Parmeliaceae*. *Nesolechia oxyspora* is probably common in the Iberian Peninsula, from which it has been previously reported by NAVARRO-ROSINÉS & HLADUN (1987: 437) and HAFELLNER & SANCHO (1990: 372). It is a widespread lichenicolous fungus.

Specimens: SPAIN, Castelló: Vilafamés, San Miguel, UTM: 30SYK4840, arenisca, (on *Parmelia somloensis*), 500m, 6.IX.1993, V. Calatayud, VAB-lich. 7355. - Castelló: Pina de Montalgrao, Sta. Bárbara, UTM: 30SYK0233, arenisca, (on *Parmelia pulla*), 1300 m, 21.III.1992, V. Calatayud, VAB-lich. 2691. - *Ibid.*, (on *Parmelia verruculifera*), VAB-lich. 7492. - Cuenca: Talayuelas, Pico Ranera, UTM: 30SXX4408, conglomerado silíceo, (on *Parmelia somloensis*), 1200 m, 16.II.1993, V. Calatayud & V. J. Rico, VAB-lich. 2754. - Teruel: Noguera, puerto de Noguera, UTM: 30TXK18, arenisca, (on *Parmelia conspersa*), 1500 m, 23.XI.1993, V. Calatayud, E. Calvo & M. J. Sanz, VAB-lich. 7493. - València: Serra, El Garbí, UTM: 30SYJ2597, arenisca, (on *Parmelia protomatrae*), 575 m, 18.X.1992, V. Calatayud, VAB-lich. 2645. - *Ibid.*, (on *Parmelia protomatrae*), VAB-lich. 2675.

Opegrapha physciaria (Nyl.) D. Hawksw. & Coppins

This *Opegrapha* species with 3-septate ascospores develops typical erumpent ascomata on the thallus of *Xanthoria parietina*. *Opegrapha physciaria* has been previously reported from Spain by SANTESSON (1960: 516, sub *Leciographa physciaria* (Nyl.) Oliv.), GIRALT & GOMEZ-BOLEA (1988: 196, sub *Leciographa physciaria* (Nyl.) Oliv.) and ATIENZA (1992: 160-162), who provides a detailed description of this species. It has been found in Sweden, France, Great Britain, Germany and Spain.

Specimens: SPAIN, Almería: Campo de Dalías, Punta Sabinal, UTM: 30SWF2260, on *Pistacia lentiscus* L., (on *Xanthoria parietina*), 10 m, 16.III.1993, E. Barreno, V. Calatayud & M. J. Sanz, VAB-lich. 7218. - Soria: Calatañazor, on *Juniperus thurifera* L., (on *Xanthoria parietina*), 1015 m, 29.VI.1992, E. Calvo, VAB-lich. 5228.

Phaeosporobolus usneae D. Hawksw. & Hafellner

At the present time, the genus *Phaeosporobolus* include two species (ALSTRUP & HAWKSWORTH, 1990). *Phaeosporobolus usneae* occurs on a wide range of macrolichens, but this is the first report on *Hypogymnia physodes*. We do not know of any previous citations from Spain of this species, whose distributional range includes several countries of the N. Hemisphere.

Specimen: SPAIN, Teruel: Cedrillas, nacimiento del río Mijares, on *Pinus sylvestris* L., (on *Hypogymnia physodes*), 21 V.1993, V. Atienza & S. Fos, VAB-lich. 5313.

Phoma cytospora (Vouaux) D. Hawksw.

This coelomycete produce discoloured patches on the thallus of *Parmelia saxatilis*, *P. sulcata* and *Parmeliopsis ambigua*. *P. ambigua* is a new host genus and species for this fungus, which was previously known only on *Parmelia* sens. lat. species (HAWKSWORTH, 1981: 51). We do not know of any previous citations from Spain, but *Phoma cytospora* is widely distributed in Europe.

Specimens: SPAIN, Navarra: A 20 Km au nord de Pamplona, Lisazo, on *Quercus robur* L./ *Q. petraea* (Matt.) Liebl., dans une chênaie, (on *Parmelia saxatilis*), 21.VII.1991, P. Diederich & J. Etayo, herb. Diederich 9622. - Navarra: N Ochagavía, Fôret d'Iraty, au NNE du lac, réserve naturelle "Lizardoya", on *Fagus* L., dans une hêtraie, (on *Parmelia sulcata*), 19.VII.1991, P. Diederich & J. Etayo, herb. Diederich 9677. - Navarra: Au nord de Orbaiceta, au nord de la Fabrica de Orbaiceta, on *Fagus* L., (on *Parmelia sulcata*), 19.VII.1991, P. Diederich & J. Etayo, herb. Diederich 9627. -

Teruel: Cedrillas, nacimiento del río Mijares, on *Pinus sylvestris* L., (on *Parmeliopsis ambigua*), 1500 m, 21.V.1993, V. Atienza & S. Fos, VAB-lich. 5237.

***Polysporina lapponica* (Ach. ex Schaerer) Degel.**

This lichenicolous fungus is close to *Polysporina simplex*, an autotrophic species from which, if one assumes that *Polysporina* is not an originally non-lichenized genus, it could be evolved. *P. lapponica* is well-known in Spain (CALATAYUD & BARRENO, 1994: 34), in which it has been reported growing only on brown *Acarospora* species, but, according to TRIEBEL *et al.* (1991: 284), it also may occur on *Buellia* and *Candelariella*. The distributional range of this species includes Europe and N. America.

Specimens: SPAIN, Castelló: Almonacid, Pico Espadà, UTM: 30SYK2420, arenisca, (on a brown *Acarospora*), 920 m, 14.II.1992, V. Calatayud, VAB-lich. 2414. - Castelló: Azuebar, Bco. Mosquera, UTM: 30SYK2517, arenisca, (on a brown *Acarospora*), 620 m, 6.VII.1991, V. Calatayud, VAB-lich. 2569. - València: Gilet, Sancti Spiritu, UTM: 30SYJ2795, arenisca, (on *Acarospora nitrophila*), 300 m, 15.IV.1993, V. Calatayud, VAB-lich. 2999.

***Rinodina insularis* (Arnold) Hafellner**

In eastern Spain, this species occurs from time to time on *Lecanora rupicola* (CALATAYUD & BARRENO, 1994: 35). The collections studied have some algae in the margin, but never develop a true thallus. *Rinodina insularis* is known from Europe, N. America, and Australia and has been previously reported from Spain several times (e.g. NAVARRO-ROSINES & HLADUN, 1987: 439).

Specimens: SPAIN, Castelló: Pina de Montalgrao, Sta. Barbara, UTM: 30SYK0233, arenisca, (on *Lecanora rupicola*), 1300 m, 21.III.1992, V. Calatayud, VAB-lich. 2497. - *Ibid.*, VAB-lich. 7296. - Tenerife: Arafo, Altos de Arafo, Barranco de la Laja, roca volcánica, (on *Lecanora rupicola* v. *efflorens*), 23.IV.1987, E. Barreno & A. Santos, VAB-lich. 7562.

***Roselliniella atlantica* Matzer & Hafellner**

All the samples examined were on *Parmelia pulla*, but this lichenicolous fungus also occurs on other groups in *Parmelia* sens. lat. (MATZER & HAFELLNER, 1990: 55). Its distributional range includes the British Isles, France, and Sweden; here is reported for the first time from Spain.

Specimens: SPAIN, Castelló: Bejis, los Cloticos, UTM: 30XK9321, arenisca, (on *Parmelia pulla*), 820 m, 23.III.1992, V. Calatayud, VAB-lich. 7464. - València: Serra, El

Garbí, UTM: 30SYJ2597, arenisca, (on *Parmelia pulla*), 575 m, 10.VIII.1992, V. Calatayud, VAB-lich. 7309.

***Tephromela campestricola* (Nyl.) Rambold**

The species *Phacopsis campestricola* was recently transferred to the genus *Tephromela* mainly on the basis of its violet-brown hymenium and epithecium, its thick-walled paraphyses and the *Bacidia*-type asci (RAMBOLD, 1993: 282). This species is not rare in the eastern Spanish territories, as a commensal on the thalli and apothecia of *Lecanora clauzadei* B. de Lesd. (= *Lecanora pseudistera* Nyl.?). Although taxa referred to *Phacopsis* have been reported on many host genera, this genus now seems to be restricted to genera in the *Parmeliaceae*. *T. campestricola* is known from East Africa and Europe, including Spain (CALATAYUD & BARRENO, 1994: 33, sub "*Phacopsis*" *campestricola* (Nyl.) Vouaux). The citation of NAVARRO-ROSINES & HLADUN (1990: 80) on a *Verrucaria* appears dubious to us.

Specimens: SPAIN, Castelló: Azuebar, Bco. Mosquera, UTM: 30SYK2517, arenisca, (on *Lecanora clauzadei*), 620 m, 14.II.1992, V. Calatayud, VAB-lich. 7317. - Castelló: Alfondeguilla, Pico Femella, UTM: 30SYK3415, arenisca, (on *Lecanora clauzadei*), 600 m, 20.I.1990, V. Calatayud, VAB-lich. 7496. - Castelló: Benicassim, Villa Comba, UTM: 30SBE4834, arenisca, (on *Lecanora clauzadei*), 300 m, 7.X.1990, V. Calatayud, VAB-lich. 7497. - València: Serra, El Garbí, UTM: 30SYJ2597, arenisca, (on *Lecanora clauzadei*), 575 m, 18.X.1992, V. Calatayud, VAB-lich. 7317. - *Ibid.*, 10.VIII.1992, VAB-lich. 7362. - València: Torres Torres, UTM: 30SYK2602, arenisca, (on *Lecanora clauzadei*), 250 m, 17.IV.1993, V. Calatayud, VAB-lich. 7087.

***Toninia plumbina* (Anzi) Hafellner & Timdal**

This species was previously included in the genus *Bacidia* and recently transferred to *Toninia* (TIMDAL, 1991: 85). It was found commensalistic on *Degelia plumbea*, in a rather humid locality, within a forest of *Abies pinsapo*, which is an original Spanish endemic tree. *Toninia plumbina* is known from western Europe and Sardinia, and in the Iberian Peninsula it has been previously reported twice from northern Spain sub *Bacidia plumbina* (SANTESSON, 1960: 513; ETAYO, 1989); this found is the first from the southern Spanish territories.

Specimen: SPAIN, Cadiz: Grazalema, Benamahoma, UTM: 30STF8474, *Abies pinsapo* Boiss., (on *Degelia plumbea*), 1580 m, 19.III.1993, E. Barreno, V. Calatayud & M. J. Sanz, VAB-lich. 7463.

***Vouauxiella lichenicola* (Vouaux) Petrak & H. Sydow**

A well-known fungus with chains of smooth-walled conidia. All the samples studied were on *Lecanora chlarotera*, the most frequent host species, as mentioned in HAWKSWORTH (1981: 65). The distributional range of *Vouauxiella lichenicola* includes Europe, N. Africa and N. America. It has previously been reported several times from Spain (e.g. SANTESSON, 1960: 519; GIRALT & GOMEZ-BOLEA, 1988: 197).

Specimens: SPAIN, Soria: Calatañazor, on *Juniperus thurifera* L., (on *Lecanora chlarotera*), 1015 m, 29.VII.1992, E. Calvo, VAB-lich. 5235. - València: Rincón de Ademuz, Puebla de San Miguel, La Saladilla, Cerro Calderón, on *Pinus sylvestris* L., (on *Lecanora chlarotera*), 29.VI.1992, V. Atienza, VAB-lich. 5234.

***Vouauxiella verrucosa* (Vouaux) Petrak & Sydow**

This coelomycete has distinctly verrucose conidia. It has been found several times both on epiphytic and saxicolous species of the *Lecanora subfusca* group. It is known from western Europe, Argelia, and Pakistan. GIRALT & GOMEZ-BOLEA (1988: 197) reported this species from the Iberian Peninsula for the first time.

Specimens: SPAIN, Soria: Calatañazor, on *Juniperus thurifera* L., (on *Lecanora sienae*), 1015 m, 29.VII.1992, E. Calvo, VAB-lich. 5229. - València: Puçol, El Picaio, UTM: 30SYJ3091, arenisca, (on *Lecanora campestris*), 350 m, 16.VII.1990, V. Calatayud, VAB-lich. 2625. - Valencia: Rincón de Ademuz, Puebla de San Miguel, La Canaleja, on *Juniperus communis* L., (on *Lecanora* sp.), 1440 m, 1.VII.1993, V. Atienza, S. Fos & V. Calatayud, VAB-lich. 5233. - *Ibid.*, UTM: 30TXK6037, on *Juniperus thurifera* L., (on *Lecanora* sp.), 1440 m, 1.VII.1993, V. Calatayud, V. Atienza & S. Fos, VAB-lich. 7498.

***Xanthoriicola physciae* (Kalchbr.) D. Hawksw.**

This hyphomycete grows both on the apothecia and thalli of *Xanthoria parietina*. It is a well-known species in Europe, previously reported from Spain by SANTESSON (1960: 520, sub *Coniosporum physciae* (Kalchbr.) Sacc.) and GIRALT & GOMEZ-BOLEA (1988: 198).

Specimens: SPAIN, Castelló: Morella, El Campello, UTM: 30TYK354903, on *Quercus rotundifolia* Lam., (on *Xanthoria parietina*), 1000 m, 12.II.1994, V. Calatayud, VAB-lich. 7499. - Soria: Parque Natural del Rio Lobos, on *Juniperus thurifera* L., (on *Xanthoria parietina*), 1000 m, 29.VI.1992, E. Calvo, VAB-lich. 5232. - Teruel: carretera entre Cedrillas y Alcalá de la Selva, on *Corylus avellana* L., (on *Xanthoria parietina*), 1500 m, 22.X.1993, V. Atienza, VAB-lich. 5355.

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**BUNODOPHORON MELANOCARPUM, COMB. NOV.
(SPHAEROPHORACEAE, CALICIALES S. LAT.)****Mats Wedin**

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Abstract: The new combination *Bunodophoron melanocarpum* (Sw.) Wedin is made, and the nomenclatural and taxonomic problems regarding this name are discussed briefly.

Bunodophoron A. Massal. was recently resurrected (Wedin 1993) following a hypothesis on the phylogeny of the family Sphaerophoraceae (Caliciales s. lat.) based on a cladistic parsimony analysis. *Bunodophoron* includes the majority of the species formerly classified in the genus *Sphaerophorus* Pers. In that paper, I briefly mentioned the largely unsolved taxonomic and nomenclatural problems in the "*Sphaerophorus melanocarpus*"-complex. The type species of *Bunodophoron*, *B. australe* (Laur.) A. Massal., distributed in temperate areas of the Southern Hemisphere, was considered distinct from the other material traditionally lumped into "*Sphaerophorus melanocarpus*". The remaining taxonomic problems regarding this species-complex were left for future studies, and no other name were suggested for these other collections, which most probably represents several species. To provide such a name which can be used for this species complex until the remaining taxonomic problems have been solved, the combination *Bunodophoron melanocarpum* is suggested here. The name is the oldest in the complex and will under any circumstances come in use for one part of it.

***Bunodophoron melanocarpum* (Sw) Wedin, comb. nov.**

Basionym: *Lichen melanocarpum* Sw., Swartz 1788: 147. - *Sphaerophorus melanocarpus* (Sw.) DC in Lam. & DC 1815: 178 (as "*Sphaerophoron melanocarpon*"). Type: Jamaica, Swartz (SBT, lectotype, designated here; UPS-THUNBERG, islectotypes).

Nomenclatural note: The lectotypification of *Lichen melanocarpum* by Ohlsson (1974: 133-134), validated by Tibell (1987) is not accepted by me. I have, despite several attempts, not been able to relocate the collection

selected by Ohlsson in Stockholm (S). According to Ohlsson (1974: 134), this collection belongs to the Swartz' herbarium, but as it contains no data on locality and collector, it is not in accordance with the protologue and cannot be regarded as original material. There are, however, syntypes annotated "Jamaica, Swartz" in the Swartz collection in the Bergius Botanical Garden in Stockholm (SBT), and in the Thunberg herbarium in UPS. The material in SBT consists of two small pieces of which the fertile piece to the left is designated lectotype. TLC of a small fragment revealed the presence of sphaerophorin, stictic and constictic acids. The material in UPS-THUNBERG consists of several small pieces, which may originate from different collections. Two small fragments analysed by TLC contained sphaerophorin only. In addition, the sheet in UPS-THUNBERG contains two pieces of *Sphaerophorus globosus* (Huds.) Vain. which have later been attached to the sheet.

The combination *Sphaerophorus melanocarpus* was published in vol. 6 of the 3rd edition of Flore Française and not the 2nd edition, as erroneously stated by Zahlbruckner (1922: 693). The correct year of printing for vol. 6 of this edition is 1815 (Stafleu & Cowan, 1976).

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A CHEMICAL AND MORPHOLOGICAL ARRANGEMENT OF THE LICHEN GENUS *PERTUSARIA*: ADDITIONAL DATA AND CORRECTIONS

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ABSTRACT: Chemical data are listed for additional taxa in the lichen genus *Pertusaria*. 57 taxa are placed in subgenus *Pertusaria* and 13 taxa are placed in subgenus *Monomurata*, section *Monomuratae*. Hypoprotocetraric acid, divaricatic acid, and sekikaic acid are reported as new compounds in the genus *Pertusaria*.

INTRODUCTION

It was recently proposed that the lichen genus *Pertusaria* be divided into three subgenera and two sections on the basis of chemistry, morphology and spore number, and a list of taxa in each subgenus, together with their chemistry was given (Archer 1993). This note describes the chemistry of additional *Pertusaria* taxa and allocates them to the proposed subgenera on the basis of their chemistry and morphology. The new reports are based on the literature (Dibben & Poelt 1987, Gilbert & Coppins 1992, Øvstedal & Smith 1992, Awasthi & Srivastava 1993, Archer & Elix 1993, Lumbsch et al. 1993, Archer & Elix 1994, Archer & Elix 1994a, Elix et al. 1994, Elix et al. 1995) and the examination of type specimens, from G, H, PREM, TUR-V, S and W, except in the case of *Pertusaria patagonica* Müll.Arg. where specimens from the type locality were examined, and additional recent collections in Australia. In addition, several lichen compounds are reported as new to the genus.

The compounds were identified by thin-layer chromatography (Elix & Ernst-Russell 1993) and liquid chromatography (Feige et al. 1993). Only the major lichen compounds found are reported although these are often accompanied by traces of biosynthetically related compounds.

CHEMISTRY

2'-*O*-Methyldivaricatic acid and 2,2'-di-*O*-methyldivaricatic acid occur (Elix et al., 1994) with 2'-*O*-methylstenosporic acid as major compounds in the holotype of *Pertusaria tuberculifera* Nyl. f. *velloziae* Vainio [TUR-V 6771] described from Brazil (Vainio 1890: 108). 2-*O*-Methylhyperlatolic and 2-*O*-methylsuperatolic acids occur (Elix et al., 1994) as major compounds in the holotype of *Pertusaria modesta* Müll.Arg. [Venezuela, Caracas, Ernst, 1878 (G)] (Müller 1884) and in *Pertusaria follmanniana* Archer & Elix from Australia. Divaricatic acid has been shown to be a major lichen acid in a specimen of an un-named 8-spored corticolous species collected near Sydney, Australia [Archer P 705] and sekikaic acid occurs, together with lichexanthone and stictic acid, in a specimen of an un-named variety of *Pertusaria dehiscens* Müll.Arg. from eastern Australia [Archer P 377]. Hypoprotocetraric acid was found in *Pertusaria vallicola* Elix & Malcolm from New Zealand (Elix et al. 1995).

Ochrolechia geminipara (Th.Fr.) Vainio has recently been transferred to the genus *Pertusaria* (Brodo 1984, Hanks et al. 1985, Purvis et al. 1992) as *Pertusaria geminipara*

(Th.Fr.) Knight (Brodo 1984, Purvis et al. 1992) or *Pertusaria geminipara* (Th.Fr.) Brodo (Hanko et al. 1985). The unusual chemistry of this taxon, namely the occurrence of the β -orcinol benzyl esters alectorialic and barbatolic acids, and the small spores suggest that this taxon does not belong in the subgenus *Pertusaria* as recently defined (Archer 1993).

The two syntypes of *Pertusaria grisea* Vainio var. *trachythallina* Räs. (Räsänen 1932) [Chile, *H. Roivainen*, Feb. 1929 (H)] contain hypothamnolic and protocetraric acids. In spite of the presence of hypothamnolic acid, the specimens gave no colour with alkali (possibly because of the low concentrations of hypothamnolic acid) but reacted P+ orange, due to the protocetraric acid. Lamb noted (in sched.) that the specimens were quite unlike *Pertusaria grisea* Vainio and it is suggested here that these sterile specimens possibly belong to the genus *Siphula*.

CORRECTIONS

Pertusaria casta Zahlbr. was previously placed in subgenus *Pertusaria* (Archer 1993:10) on the basis of Zahlbruckner's report of double-walled spores (Zahlbruckner 1936:172). However examination of the type specimen [South Africa, C.P., Knysna, *van der Bijl* 861 (PREM)] showed that the spores have a thin, single wall, 3–5 μ m thick so the species is more properly placed in subgenus *Monomurata*.

Pertusaria coccodes (Ach.) Nyl. has asci with two spores (Purvis et al. 1992:451) and not four as previously reported (Archer 1993:12).

The following taxa are allocated to the subgenera shown on the basis of chemistry and morphology:

Subgenus *Pertusaria*.

Sterile, usually sorediate.

<i>P. flavocorallina</i> Coppins & Muhr	?thiophaninic acid & ?arthothelin
<i>P. flavoisidiata</i> Archer & Elix	thiophaninic & stictic acids
<i>P. maritima</i> Archer & Elix	thiophaninic & stictic acids
<i>P. puffina</i> Archer & Elix	2,4- & 2,5-dichlorolichexanthonones, 2,4,5-trichlorolichexanthonone & stictic acid

Spores 2 per ascus

<i>P. christae</i> Dibben & Poelt	2'-O-methylperlatolic acid
<i>P. elliptica</i> Müll.Arg. var. <i>bispora</i> Elix & Archer	2-chlorolichexanthonone, 2,5-dichlorolichexanthonone, 2,4,5-trichlorolichexanthonone, 2-O-methyl- and 2'-O-methylperlatolic acids
<i>P. hadrospora</i> Archer & Elix	nil
<i>P. indica</i> Srivastava & Awasthi	2'-O-methylperlatolic acid
<i>P. limosa</i> Zahlbr.	2-chloro-6-O-methylnorlichexanthonone & stictic acid
[syn: <i>P. pustulata</i> (Ach.) Duby]	
<i>P. malabara</i> Archer & Elix	6-O-methylarthothelin & thiophanic acid
<i>P. melaleucoides</i> Müll.Arg.	nil
<i>P. nigrescens</i> Srivastava & Awasthi	2,5-dichlorolichexanthonone, 2,4,5-trichlorolichexanthonone & stictic acid
<i>P. signyae</i> Øvst.	2'-O-methylperlatolic acid
<i>P. tetrathalamia</i> var. <i>major</i> Müll.Arg.	lichexanthonone, 2'-O-methylperlatolic & 2-O-methylperlatolic acids
<i>P. tuberculifera</i> Nyl. f. <i>velloziae</i> Vainio	2'-O-methyldivaricatic, 2,2'-di-O-methyldivaricatic & 2'-O-methylstenosporic acids
<i>P. vallicola</i> Elix & Malcolm	hypoprotocetraric acid

P. xanthonaria Archer & Elix

2,4-dichloro-, 2,5-dichloro- & 2,4,5-trichlorolichexanthenes

Spores 4 per ascus

P. follmanniana Archer & Elix

2-chlorolichexanthone, stictic, 2-*O*-methylhyperlatolic & 2-*O*-methylsuperlatolic acids

P. gracilis Müll.Arg.

lichexanthone & stictic acid

[syn: *P. albidella* Nyl. var. *tetramera* Müll.Arg.]

P. gracilis f. *heteromera* Müll.Arg.

lichexanthone, stictic & confluent acids

P. modesta Müll.Arg.

lichexanthone, 2-chlorolichexanthone

[syn: *P. depressa* sensu Müll.Arg.;

2-*O*-methylhyperlatolic & 2-*O*-methyl

P. melaleuca var. *tetramera* Müll.Arg.]

superlatolic acids

P. rechingeri Zahlbr.

2'-*O*-methylperlatolic &

thiophaninic acids

P. rhodiza Nyl.

4,5-dichlorolichexanthone & norstictic acid

P. spegazzini Müll.Arg.

2'-*O*-methylperlatolic acid

P. tapadensis Elix & Archer

4,5-dichlorolichexanthone, 2-*O*-methylperlatolic & stictic acids

P. tetrathalamia var. *confirmans* Müll.Arg.

lichexanthone

P. tetrathalamia var. *decipiens* Müll.Arg.

lichexanthone, 4-chlorolichexanthone,

[syn: *P. tetrathalamia* var. *enucleans* Müll.Arg.]

4,5-dichlorolichexanthone, stictic & constictic acids

Spores 8 per ascus

P. achroiza Nyl.

2-*O*-methylperlatolic & 2'-*O*-methylperlatolic acids

P. albissima Müll.Arg.

nil

P. alboaspera Archer & Elix

lichexanthone, stictic & 2,2'-di-*O*-methyl-

stenosporic acids

P. alboatra Zahlbr.

thiophaninic acid

P. amarkantakana Srivastava & Awasthi

2-*O*-methylperlatolic acid

P. bartlettii Archer & Elix

arthothelin, 2,4-dichloronorlichexanthone

& thiophanic acid

P. celata Archer & Elix

salazinic acid

P. cerebrinula Zahlbr.

2'-*O*-methylperlatolic acid

[syn: *P. alta* Zahlbr.]

P. confundens Nyl.

4,5-dichlorolichexanthone

P. congesta Vainio

lichexanthone, stictic & 2,2'-di-*O*-methylstenosporic acids

P. delicatula Müll.Arg.

2-chlorolichexanthone, constictic & stictic acids

P. dilatata Müll.Arg.

nil

P. dissita Elix & Archer

thiophaninic, stictic & hypostictic acids

P. duppensis Archer & Malcolm

nil

P. endoxantha Vainio

norstictic acid

P. enterostigmoides Zahlbr.

4,5-dichlorolichexanthone & norstictic acid

P. gibberosula Nyl.

stictic acid.

P. glaucocinera Vainio

lichexanthone, stictic & 2,2'-di-*O*-methylstenosporic acids

P. glaziovii Müll.Arg.

thiophaninic and protocetraric acids

P. himalayensis Awasthi & Srivastava

norstictic acid

P. howeana Archer & Elix

6-*O*-methylarthothelin & arthothelin

P. huneckiana Feige & Lumbsch

thiophaninic & norstictic acids

P. idukkiensis Awasthi & Srivastava

6-*O*-methylarthothelin & arthothelin

P. lordhowensis Archer & Elix

2,4- & 2,5-dichlorolichexanthone & 2,4,5-trichlorolichexanthone

- P. major* Müll.Arg.
P. mundula Müll.Arg.
P. nana Müll.Arg.
P. oblongata Müll.Arg.

P. papillulata Nyl.
[syn: *P. pustulata* (Ach.) Duby var. *erythrina* Räs.]
P. parvula Archer & Elix
P. patagonica Müll.Arg.
P. rhodostoma Nyl.
P. rhodostomoides Vainio
P. rimosa Awasti & Srivastava

P. scottii Elix & Archer

P. splendens Awasti & Srivastava
P. sporellula Archer & Elix
P. torquatella Müll.Arg.
P. torquatella var. *ferax* Müll.Arg.

P. tuberculifera var. *ferax* Müll.Arg.
P. tyloplaca Nyl.
- lichexanthone & stictic acid
 4,5-dichlorolichexanthone
 2'-*O*-methylperlatolic and confluent acids
 6-*O*-methylarthothelin, arthothelin, 2,4-dichloronorlichexanthone & 2,5-dichloronorlichexanthone
 6-*O*-methylarthothelin & arthothelin
 4,5-dichlorolichexanthone
 norstictic acid
 thiophaninic acid
 lichexanthone & protocetraric acid
 4,5-dichlorolichexanthone & 2-*O*-methylstenosporic acid
 4,5-dichlorolichexanthone & 2-*O*-methylperlatolic acid
 lichexanthone & stictic acid
 nil
 2-chlorolichexanthone
 2,5-dichlorolichexanthone & 2,4,5-trichlorolichexanthone
 lichexanthone & stictic acid
 stictic acid

Subgenus *Monomurata* Archer section *Monomuratae* Archer

Sterile, usually sorediate

- P. amara* (Ach.) Nyl. var. *tucumanensis* Räs.
P. colorata Awasthi & Srivastava
P. miniatescens Archer & Elix
P. psoromica Archer & Elix
P. subventosa Malme var. *deficiens* Archer & Elix
P. subventosa Malme var. *hypothamnolica* Archer & Elix
- lichexanthone & hypothamnolic acid
 norstictic acid
 norstictic acid
 psoromic acid
 lichexanthone & picrolichenic acid
 lichexanthone, picrolichenic & hypothamnolic acids

Spores 1 per ascus

- P. casta* Zahlbr.
P. flavovelata Elix & Malcolm
P. reducta Stirt. var. *hossei* Räs.

P. scutellifera Archer & Elix
- norstictic acid
 picrolichenic acid
 lichexanthone, picrolichenic & hypothamnolic acids
 thamnolic acid

Spores 2 per ascus

- P. murrayi* Elix & Archer
P. rugifera Müll.Arg.
- gyrophoric acid
 picrolichenic & norstictic acids

Spores 8 per ascus

- P. darbishireana* Zahlbr.
[syn: *P. erubescens* Nyl.]
P. pycnophora Nyl.
P. solitaria Darbishire
[syn: *P. erubescens* Nyl.]
- norstictic acid
 lichexanthone & lecanoric acid
 norstictic acid

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***STRIGULA PORINOIDES* SP. NOV. (ASCOMYCETES, LICHENES) FROM THE MEDITERRANEAN KARSTIC REGIONS**

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ABSTRACT: A new species *Strigula porinoides* Canals, Boqueras & Gómez-Bolea, found in karstic cavities in Catalonia (NE Spain), is described and illustrated. This lichen is calcicolous and occasionally corticolous and is characterised by its submuriform ascospores and macroconidia.

During a survey of the lichen flora in the vertical caves in the mediterranean region of NE Spain we detected a *Strigula* clearly distinct from all hitherto described species. After confirmation by Dr Harris (in litt.), it is described herein as a new species.

The new species is named *porinoides*, due to its macroscopic similarity to *Porina oleriana* (Massal.) Lett.

***Strigula porinoides* Canals, Boqueras & Gómez-Bolea sp. nov.**

(Figs. 1, 2, 3)

Thallus crustaceus, hemiendolithicus, subgriseus vel griseo-viridis, continuus vel subtiliter rimosus, 180-250 μ m crassus. Alga a generem *Trentepohliam* pertinens, cellulis 7-15 μ m diametro. Perithecia semiimmersa, solitaria, numerosa, globosa, 0.5-0.8 mm diametro. Involucrellum nigrum, ad 2/3 excipuli descendens, 75-100 μ m crassum. Apex rotundatus. Ostiolum minutissimum, centrale. Excipulum incolor, 20-25 μ m. Hymenium I- et KI-. Paraphyses simplicis cum aliquis, paucis, ramis, ad 2 μ m latae. Periphyses non vidi. Asci bitunicati, 8-spori, elongati-cylindrici, 90-105 x 12-15 μ m, apicibus rotundatis cum minuta camera. Ascosporae incoloratae, fusiformes, aliquae leviter sigmatae, submuriformes, (5-) 6-8 septis transversis et (0-1-) 2-4 septis longitudinalibus, 22-32 x 5-7 μ m, parietibus tenuibus, plerumque halonatis, halo 3 μ m crasso. Macropycnidia 0.3-0.4 mm diametro, immersa, apicibus nigra. Macroconidiis fusiformis, submuriformis, (5-) 7 septis transversis et 0-2 septis longitudinalibus, 24-26 x (5-) 5.5-6 μ m, parietibus tenuibus, apicibus in muco-appendices percurrenter. Micropycnidia 0.15 mm diametro, semiimmersa, apicibus nigra. Microconidiis oblongis, 3-4.5 x 1.5 μ m. Materia chemica: K-, C-, KC-.

TYPUS: Spain, Catalonia, province of Barcelona, Baix Llobregat, Vallirana, avenc de les Portes, ad saxa dolomitica, UTM 31TDF1081, 310-325 m, 12 October 1989, *A. Canals*, (Holotypus, BCC-Lich. 5740).

Thallus crustose, hemiendolithic, pale grey to pinkish white or greenish, continuous to rimose, smooth to pulverulent, 180-250 μm thick with crystalline inclusions more abundant in the lower parts. Photobiont *Trentepohlia* sp. with cells 7-15 μm diameter.

Perithecia arising singly, scattered, semiimmersed in the thallus, subglobose, carbonaceous, extending to 2/3 of the perithecia, slightly more dilated near the ostiole. *Excipule* colourless, prosoplectenchymatous, 20-25 μm thick at the base. *Hymenium* I-, KI-. *Paraphyses* thread-like, unbranched or rarely branched, 2 μm thick. *Periphyses* not observed. Subhymenium hyaline. *Asci* 8-spored, elongate-cylindrical, with round apex, thickened at the tip of the endoascus, with a small ocular chamber, I-, KI-, 90-105 $\times$ 12-15 μm . *Ascospores* colourless, mostly fusiform, sometimes slightly sigmoid, submuriform, with (5-)6-8 transverse and (1-)2-4 longitudinal septa, 22-32 $\times$ 5-7 μm . Ascospore wall 1 μm thick, smooth, some with a gelatinous halo 3 μm thick.

Macropycnidia 0.3-0.4 mm in diameter, black at the tip, immersed, guttulate. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialides, subcylindrical, hyaline, smooth walled, 8.5-10.5 $\times$ 4 μm . *Macroconidia* colourless, subcylindrical to ellipsoidal, rounded at the ends, smooth walled, transverse septate with (5-) 7 septa to submuriform with 0-2 longitudinal septa, 24-26 $\times$ (5-) 5.5-6 μm , with mucoid appendages at the ends.

Micropycnidia 0.15 mm in diameter, black at the tip, semiimmersed. *Conidiogenous cells* cylindrical, more or less curved, 13-14 $\times$ 1.7 μm . *Microconidia* colourless, oblong, 3-4.5 $\times$ 1.5 μm , without mucoid appendages.

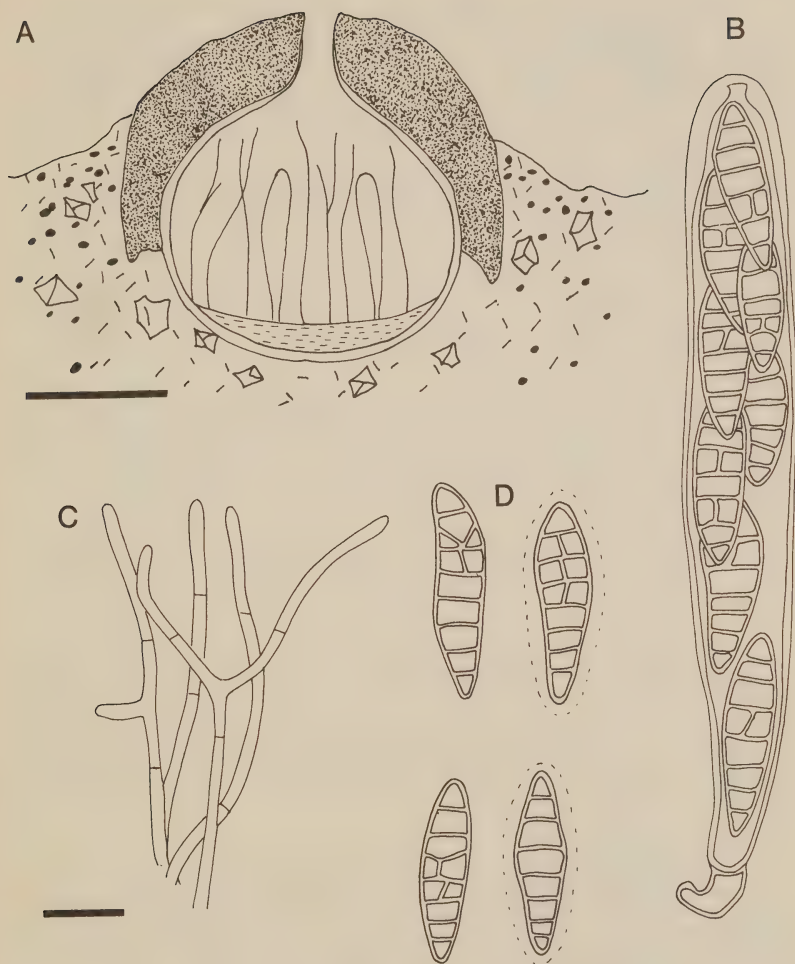
Chemistry: thallus K-, C- and KC-.

Habitat: *Strigula porinoides* is found mainly on calcareous rocks, occasionally on bark. We have collected *S. porinoides* in several subterranean cavities of Catalonia, in the area of the Garraf mountain chain (province of Barcelona), growing with *Opegrapha vulgata* (Ach.) Ach., *O. variaeformis* Anzi, *Strigula calcarea* Bricaud & Roux, *Petractis thelotremella* (Bagl.) Vèzda, *Lecania cuprea* (Massal.) v. d. Boom & Coppins (PURVIS et al. 1992) and "*Catillaria*" sp.

S. porinoides mainly develops mainly in the middle zone of the cavities (CANALS & GOMEZ-BOLEA, 1992), where the humidity is near saturation and temperatures are more stable than in the outer areas. In these conditions thalli can grow to more than 1 m in diameter. Occasionally it can be found in the outer parts of the cavity, as a dispersed thallus of smaller size.

Only once have we collected *S. porinoides* outside the cavities, in the Ports of Tortosa (province of Tarragona), on the smooth-barked trunk of *Ilex aquifolium* L., growing besides a calcareous wall and protected by fallen blocks. It was found with *Acrocordia cavata* (Ach.) R.C. Harris, *Arthonia radiata* (Pers.) Ach. and *A. cinnabarina* (DC.) Wallr.

Recently, it has been found on the Island of Marettimo (Isole Egadi, W-Sicily), on shaded surfaces of calcareous rocks at 400 m (NIMIS et al. 1994).



Observations: This new species shares many essential characters with the type species of the genus, *Strigula smaragdula* Fr., according to the concept of the genus as described by HARRIS (1973, 1975): the apical structure of its ascus (thickened at the tip of the exoascus and with a small ocular chamber), its paraphyses thread-like, unbranched or occasionally forked, and the presence of both macro- and microconidia.

The majority of species of *Strigula* described until now grow on leaves, bark, plant debris and moss. *S. affinis* (Massal.) R.C. Harris and *S. taylorii* (Carroll ex Nyl.) R.C. Harris can be found occasionally on rocks. *S. calcarea* Bricaud et Roux (BRICAUD et ROUX, 1991) and *S. endolitheia* Roux et Bricaud ad int. (ROUX et BRICAUD, 1993) are also saxicolous. *S. calcarea* differs from *S. porinoides* by the thin and pale excipulum, without involucrellum; the triseptate ascospores, (15-) 17-22 (-23) x (4-) 5-7 (-8) μm and macroconidia with 3 or 5-7 longitudinal septa. *S. endolitheia* differs in the macroconidia (16-) 20-28 (-34) x (3.5-) 4-4.5 (-5) μm with 5-7 septa.

S. porinoides is the first European species with submuriform ascospores and macroconidia. NIMIS et al. (1994) found that the variability of ascospores and macroconidia is more than we have observed: 24-34 x 6-8 (9) μm with 7-10 (12) transverse and 1-4 longitudinal septa, and macroconidia measuring 19-26 (35) x 4.5-6.5 (8.5) μm .

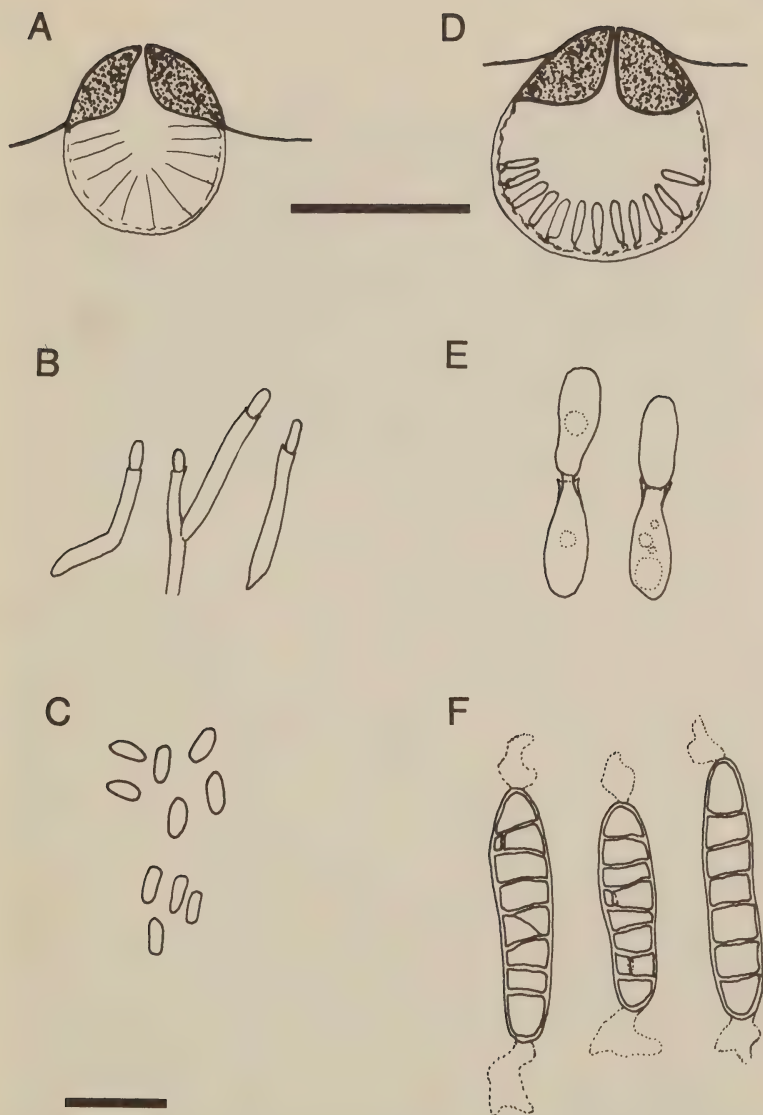
Another similar species, *S. submuriformis* (R.C. Harris) R.C. Harris, is rare in North America (HARRIS, 1975), and differs from *S. porinoides* in the ascospores 3-septate with 1-2 longitudinal septa, macroconidia with 7-septa and different habitat.

Selected specimens examined: Spain, Catalonia: province of Barcelona, Baix Llobregat, Vallirana, avenc del Pla de Comes, UTM 31TDF0883, 420 m, 14 November 1990, A. Canals (BCC-Lich. 5567); province of Barcelona, Baix Llobregat, Olesa de Bonesvalls, avenc dels Esquirols, UTM 31TDF0582, 400 m, 7 March 1991, A. Canals (BCC-Lich. 5568); province of Tarragona, Baix Ebre, Paüls, Montsagre de Paüls, UTM 31TBF7935, 20 October 1990, 950-1000 m M. Boqueras and A. Gómez-Bolea (BCC-Lich. 5739).

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Fig 2. *Strigula porinoides*. A, Micropycnidia (scale A = 200 μm). B and C, Conidiogenous cells and microconidia (scale B, C = 10 μm). D, Macropycnidia (scale D = 200 μm). E, Conidiogenous cells with young macroconidia. F, Mature macroconidia (scale E, F = 10 μm).



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Fig 3. *Strigula porinoides*. A, Vertical section of perithecium (Scale = 100 μ m). B, Ascus. C, Ascospores. D, Microconidia. E, Macroconidia. (Scale B-E = 10 μ m).

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A NEW SPECIES OF BOLETELLUS (BASIDIOMYCOTINA, AGARICALES: BOLETACEAE) FROM MEXICO

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ABSTRACT

Boletellus singerii is described as a new species from the Sierra Nanchititla, State of Mexico. This species is close to B. elatus Nagasawa, B. jalapensis (Murrill) Gilbert and B. longicollis (Ces.) Pegler et Young of the Sect. Ixocephalli Singer.

RESUMEN

Boletellus singerii es descrito como nueva especie de la Sierra de Nanchititla en el Estado de México. Es afín a B. elatus Nagasawa, B. jalapensis (Murrill) Gilbert y B. longicollis (Ces.) Pegler et Young de la Sec. Ixocephalli Singer.

INTRODUCTION

The genus Boletellus is a group of 33 species distributed in both tropical and temperate regions of the world (Singer, 1986). Sixteen species have been reported from Mexico, as Boletellus alveolatus (Heim & Perreau) Singer from Oaxaca (Singer et al., 1992); B. ananas (Curt.) Murrill from Guerrero, Oaxaca and Veracruz (Pérez-Silva, 1970); B. betula (Schw.) Gilbert from Durango, Guerrero, Hidalgo and State of Mexico (Quintos et al., 1984; Varela & Cifuentes, 1979; Frutis & Guzmán, 1983; Singer et al., 1992; González-Velázquez & Valenzuela, 1993); B. chrysenteroides (Snell) Snell from Jalisco, Michoacan, Nuevo Leon and Tamaulipas (García & Castillo, 1981; Singer et al., 1992); B. coccineus (Fr.) Singer from Hidalgo, Michoacan, Nuevo Leon, State of Mexico, Tamaulipas and Veracruz (Singer et al., 1992); B. cubensis (Berk. & Curt.) Singer from Quintana Roo (Singer et al., 1992); B. elatus Nagasawa from Jalisco (Singer et al., 1992); B. flocculosipes (Murr.) Perreau from Queretaro and Tamaulipas (Singer et al., 1992); B. intermedius Smith & Thiers from Tamaulipas (Singer et al., 1992); B. ivory Singer from Jalisco, Nuevo Leon and State of Mexico (García &

Castillo, 1981; García et al., 1986; Singer et al., 1992; González-Velázquez & Valenzuela, 1993); B. jalapensis (Murrill) Gilbert from Chiapas and Veracruz (Murrill, 1910; García et al., 1987; Singer et al., 1992); B. pictiformis (Murrill) Singer from Chiapas (Singer et al., 1992); B. projectellus (Murrill) Singer from Hidalgo and State of Mexico (Frutis & Guzmán, 1983; Singer et al., 1992; González-Velázquez & Valenzuela, 1993); B. pseudochrysenteroides Smith & Thiers from Hidalgo, Nuevo Leon, Queretaro and Tamaulipas (Garza et al., 1985; Garza, 1986; García et al., 1986; Singer et al., 1992); B. russellii (Frost) Gilbert from Chihuahua, Durango, Guerrero, Hidalgo, Jalisco, Nuevo Leon, Puebla, State of Mexico and Veracruz (Castillo et al., 1979; Varela & Cifuentes, 1979; Welden & Guzmán, 1978; León & Guzmán, 1980; García & Castillo, 1981; Frutis & Guzmán, 1983; Rodríguez-Scherzer & Guzmán-Dávalos, 1984; Martínez-Alfaro et al., 1983; Pérez-Silva & Aguirre-Acosta, 1985; Singer et al., 1992; González-Velázquez & Valenzuela, 1993) and B. zelleri (Murrill) Singer from Michoacan and Nuevo Leon (Singer et al., 1992). Of these, Guzmán (1977) reported B. ananas, B. betula and B. russellii.

Between 1986 and 1990, the authors made several explorations to the Sierra de Nanchititla at the State of Mexico, and they collected some specimens of Boletellus, which could not be assigned to any known species. It is hereby described as a new taxon. Observation on microscopic features were made with sections mounted in a 5% KOH solution and Melzer's reagent. The color of the basidiomata were taken in accordance with Kornerup and Wanscher (1978).

Boletellus singerii González-Velázquez et Valenzuela sp. nov.

Figs. 1 - 8

Pileus 30 - 65 mm latus, hemisphaerico, dein convexus vel plano-convexus, pallido luteus vel vivide luteus, glutinosus, laevis. Margine appendiculatus, albus. Tubulis depressis ad stipitem, pallide virens vel olivaceus, locus contusus olivaceobrunneus, 10 - 15 mm longis; poris rotundatis vel angulares, 1 - 1.5 mm latis. Stipite 45 - 110 mm longo, ad apicem 5 - 10 mm crasso et ad basim 8 - 18 mm crasso, ad apicem pallide luteus, ad basim vivide luteus, locus contusus brunneus, viscid vel glutinosus. Carne 5 - 8 mm crasso, albida, fracta pallide ruber. Velo juventute membranaceo, glutinoso, albo. Sporis in cumulo olivaceobrunneis, (8.8-) 11.2-17.6 (-19.2) x (6.0-) 6.4 - 9.6 (10.4) μ m, fusoides, cylindricus, pallide luteus vel ochraceoluteus, alatus. Basidiis 33 - 42 x 12 - 16 μ m, clavatis vel pyriformis, 2 - 4 sporigeris. Cheilocystidiis 34 - 60 x 12 - 20 μ m, fusoidis vel ventricosis, hyalinis. Pleurocystidiis 49 - 64 x 12 - 20 μ m, simillis cheilocystidiis. Tramate hymenoforali typi Boletorum. Pileipellis ixotrichodermiali, 300 - 500 μ m crasso. Stipitipellis ixotrichodermiali. Hyphis haud fibuligeris. Ad terram in quercetum-pinetum silvae. Mexico, Municipio de Tejupilco, Sierra de Nanchititla, Estado de Mexico prope. A. González-Velázquez 516 (Holotypus ENCB, Isotypus F, ITCV, XAL).

Pileus 30 - 65 mm broad, hemisphaerical when young, then convex to plane convex, pale yellow to light yellow (4A3, 4A4), glutinous, smooth, margin whitish, appendiculatus, acute, projecting into the membranous, smooth, glutinous, white veil, connecting it with the apex of stipe. Hymenophore tubular, slightly to deeply depressed around the stipe, greyish yellow (2C4) to olive (3D4), changing to olive brown (4E4) when bruised; pores round or angular, 1 - 1.5 mm wide; tubes 10 - 15 mm long, individualized and separable from each other, concolorous with the hymenophore. Stipe 45 - 110 mm long, 5 - 10 mm thick at the apex and 8 - 18 mm thick at the base, subcylindric to subbulbous, yellowish white (4A2) to pale yellow (4A3) to the apex, light yellow (4A4) to the base, changing to light brown (5D5) to golden brown when bruised, viscid to glutinous, pubescent at the apex, smooth to the base, solid, stuffed with white micelium, slowly changing to light brown (5D4) when bruised. Veil whitish, leaving remnants on the pileus and forming an annulus on the stipe; annulus membranous, with viscid covering. Context 5 - 8 mm thick, white, turning pinkish white (10A2) under the cuticle and over the tubes when exposed, odor fungical, taste acrid. Spore print olive (3D4), becoming olive brown (4E4) on drying.

Spores (8.8-) 11.2 - 17.6 (-19.2) x (6.0-) 6.4 - 9.6 (-10.4) μm , fusoids to cylindricus, with a slight suprahilar depression, pale yellow to ochraceous yellow, inamiloid, a few dextrinoid, longitudinally winged, wings up to 1.6 μm high. Basidia 33 - 42 x 12 - 16 μm , hyaline to yellowish, clavate to pear-shaped, 2 - 4 spored, sterigmata 4 - 6.4 μm long. Pleurocistidia 49 - 64 x 12 - 20 μm , hyaline, inamiloid, thin walled, fusoid to ventricose, a few clavate, without incrustations. Cheilocystidia 34 - 60 x 12 - 20 μm , hyaline, inamiloid, thin walled, fusoid to ventricose, a few clavate, with very small cristals incrustated at the apex. Hymenophoral trama bilateral, hyphae without clamp connections, hyaline to yellowish, inamiloid, 3.2 - 12.8 μm diam. Contextual hyphae without clamp connections, hyaline, inamiloid, 4 - 12.8 μm diam. Epicutis of pileus a well developed ixotrichodermium, 300 - 500 μm thick, consisting of erect, semierect to postrate branched hyphae, loosely interwoven, hyaline, inamiloid, without clamp connections, 3.2 - 10.4 μm diam. Cuticle of stipe a ixotrichodermium, with cylindrical, branched hyphae, hyaline, inamiloid, without clamp connections, 2.4 - 8.0 μm diam. Caulocystidia 28 - 64 x 6.4 - 9.6 μm , hyaline, inamiloid, thin walled, subcylindrical to clavate-pedicellate. Veil consisting of slender, cylindrical, branched hyphae, loosely interwoven, hyaline, inamiloid, without clamp connections, 4 - 7.2 μm diam.

Chemical reactions: KOH on surface of pileus, pale pink, on context negative, on hymenium changing slowly to olivaceous brown and on stipite yellowish brown. NH_4OH and FeSO_4 negatives.

Habitat. Solitary or subgregarius on soil in Quercus-Pinus forest. Fruiting from July to September.

Material studied: Mexico, State of Mexico, Municipio de Tejupilco, Sierra de Nanchititla, Sept. 6, 1986, **A. González-Velázquez 516** (Holotype ENCB, Isotypes F, ITCV, XAL), Ag. 22, 1987, **693, 715** (ENCB), July 30, 1988, **833, 855** (ENCB), Ag. 19, 1989, **1198** (ENCB), July 8, 1990, **1370** (ENCB, FCME), Ag. 20, 1989, **A. Kong-Luz 1235** (ENCB), July 8, 1990, **R. Nava 742** (ENCB).

Discussions: *Boletellus singerii* is distinguished by its special colour and glutinous pileus and stipe, as well as for its white and glutinous veil. It is related with *B. elatus*, *B. jalapensis* and *B. longicollis* (Ces.) Pegler & Young that belong to the Section Ixocephalli Singer, but differs in the non-annulate basidiomata in the former, the cinnamon brown, rugose-areolate pileus, the longest, thin and longitudinally striate stipe and the spores longer (15.2 - 25 x 8 - 13.5 μ m) than *B. singerii* in the second species and the ovoid to ellipsoid and smallest (9.5 - 15 x 8 - 12.5 μ m; Corner, 1972) in the last species. *B. singerii* was described in English in Singer *et al.*, (1992) as "*B. singerii* González-Velázquez", without any discussions. This species is named in honor to Dr. Rolf Singer for his valuable works on the agarics from Mexico.

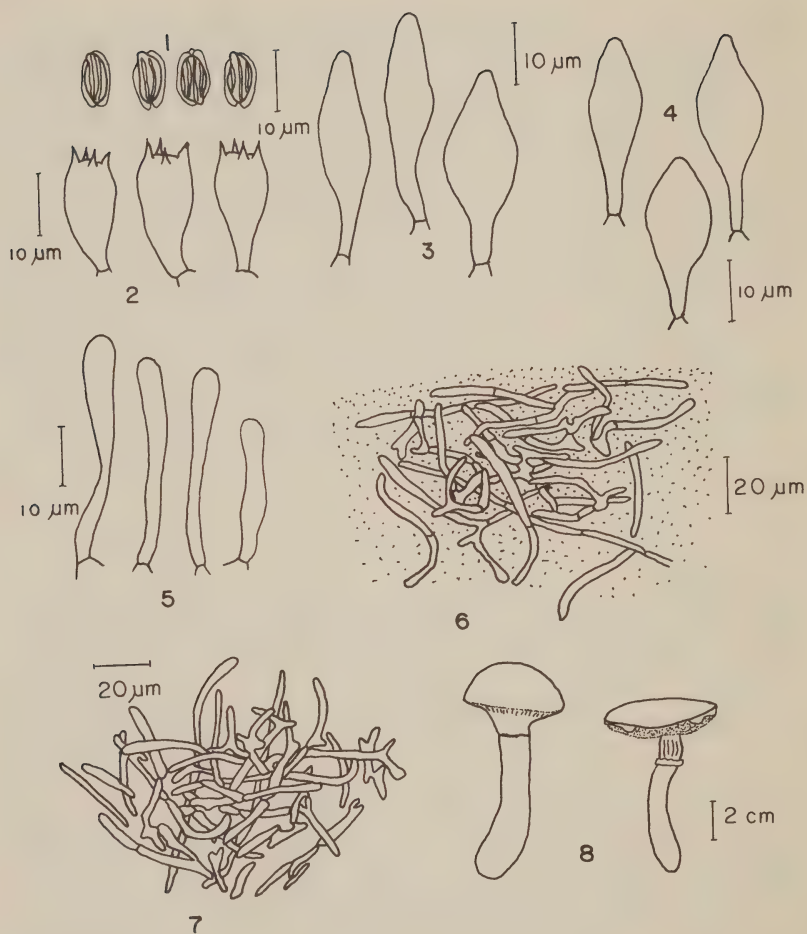
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Boletellus singerii. Figs. 1 - 8. 1: Spores. 2: Basidia. 3: Pleurocystidia. 4: Cheilocystidia. 5: Caulocystidia. 6: Epicutis of pileus. 7: Veil branched hyphae. 8: Fruiting bodies.

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BULGARIAN UREDINALES

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ABSTRACT

In the present checklist of Bulgarian Uredinales 373 rust species on 1053 vascular plants are recorded, making 1389 rust-host combinations. The synonyms of rusts publishing in the literature concerning Bulgarian Uredinales, with references to the names used in the checklist, as well as a host-rust index are listed.

INTRODUCTION

This paper attempts to compile all published data of Bulgarian rust fungi. Atanasoff & Petroff (1930) and Trifonova (1947) have published lists of diseases on plants in Bulgaria, including 173 and 105 rust species respectively in the taxonomical scheme employing here. The concepts and definitions of rust species influence the number of rusts recognizing in a particular geographic region; thus as many as 640 species were reported in Bulgaria, but I herein recognize 373 species.

The nomenclature and delimitation of rust species employed in this paper follow mostly these used by Gjaerum (1974), Gjaerum & Sunding (1986) and Majewski (1977, 1979). The author's names of rust fungi are abbreviated according to Hawksworth (1980). The nomenclature of the hosts and the floristic regions of Bulgaria (Fig. 1) are in accordance with Kozhuharov (1992).

Because many rust species have been published under different names, synonyms are listed separately with reference to the correct names used in the main list.

In the present list 373 species in 30 genera and 10 families are enumerated (Tabl. 1).

Tabl. 1

Synoptic table of Bulgarian Uredinales

Taxa	Number of species	Number of rust/host combinations
1	2	3
Pucciniastraceae		
<i>Hyalopsora</i>	2	3
<i>Melampsorella</i>	2	8
<i>Melampsoridium</i>	1	1
<i>Milesina</i>	2	2
<i>Pucciniastrum</i>	7	20
Coleosporiaceae		
<i>Coleosporium</i>	1	59
<i>Chrysomyxa</i>	3	4
Cronartiaceae		
<i>Cronartium</i>	2	4
Melampsoraceae		
<i>Melampsora</i>	15	68
Chaconiaceae		
<i>Ochropsora</i>	1	2
Uropyxidaceae		
<i>Sorataea</i>	1	2
<i>Tranzschelia</i>	3	24
Pileolariaceae		
<i>Pileolaria</i>	1	1
Phragmidiaceae		
<i>Kuehneola</i>	1	3
<i>Phragmidium</i>	11	48
<i>Trachyspora</i>	1	6
<i>Xenodochnus</i>	1	1
Sphaerophragmiaceae		
<i>Nyssopsora</i>	1	1

1	2	3
<i>Triphragmiopsis</i>	1	1
<i>Triphragmium</i>	2	2
Pucciniaceae		
<i>Cumminsiella</i>	1	1
<i>Endophyllum</i>	2	3
<i>Gymnosporangium</i>	7	20
<i>Miyagia</i>	1	4
<i>Puccinia</i>	197	751
<i>Uromyces</i>	93	323
<i>Zaghouania</i>	1	1
Anamorphic genera		
<i>Aecidium</i>	9	23
<i>Caeoma</i>	2	2
<i>Uredo</i>	1	1
Total:		
rusts	373	
hosts	1053	
rust/host combinations	1389	

This work is a part of a project “Fungi of Bulgaria. Uredinales” financing by the National Science Fund of Ministry of Sciences and Education and it is a step towards a monograph of the Balkan Peninsula rust fungi.

CHECKLIST OF BULGARIAN RUST FUNGI

The floristic regions (s. Fig. 1 on p. 37) are put between parentheses

AECIDIUM PERS. : PERS.

1. *Ae. clematidis* DC.

Clematis vitalba L. [2]

2. *Ae. doronici* Tauscher in Rabenh.

Doronicum hungaricum Rchb. [1, 16]

3. *Ae. euphorbiae* J. F.Gmelin : Pers.

Euphorbia agraria Bieb. [2], *E. apias* L. [19], *E. cyparissias* L. [2], *E. esula* L. subsp. *tommasiniana* (Bertol.) Nyman [2], *E. niciciana* Borb. [14], *E.*

plathyphyllos L.[17], *E. polychroma* Kern. [17], *E. salicifolia* Host [2, 10 19]

4. *Ae. inulae-helenii* Const.

Inula hirta L. [6]

5. *Ae. macedonicum* Sydow

Asyneuma anthericoides (Janka) Bornm. [17, 18], *A. limonifolium* (L.) Janch. [7, 12]

6. *Ae. ranunculacearum* DC.

Ranunculus bulbosus L. [10, 14], *R. ficaria* L. [2], *R. montanus* Willd. [15], *R. repens* L. [15], *R. serbicus* Vis. [15], *R. villosus* DC. subsp. *constantinopolitanus* (DC.) A. Elen. [20]

7. *Ae. scabiosae* (Dozy & Melk.) Winter in Rabenh.

Cephalaria transsylvanica (L.) Roem. & Schult. [2], *Succisa pratensis* Moench [6]

8. *Ae. scorzonerae* (Castagne) Lagerh.

Scorzonera laciniata L. [6]

9. *Ae. solms-laubachii* Boyer & Jacz.

Adonis flammea Jacq. [1]

CAEOMA WINTER in RABENH.

10. *C. allii-ursini* Winter in Rabenh.

Allium carinatum L. subsp. *pulchellum* Bonn. & Lay. [14]

11. *C. mercurialis* Link

Mercurialis perennis L. [8]

CHRYSOMYXA UNGER

12. *Ch. abietis* (Wallr.) Unger

Picea abies (L.) Karst. [15]

13. *Ch. ledi de Bary*

Rhododendron myrtifolium Schott & Kotschy [5]

14. *Ch. pyrolata* Winter in Rabenh.

Orthilia secunda (L.) House [15], *Picea abies* (L.) Karst. [8]

COLEOSPORIUM LÉV.

15. *C. tussilaginis* (Pers. : Pers.) Berk.

Adenostyles alliariae (Gouan) Kern. [15], *Aster* sp. (cult.), *Asyneuma limonifolium* (L.) Janch. [12, 19], *Calendula officinalis* L. (cult.), *Campanula alpina* Jacq. [15], *C. bononiensis* L. (cult.), *C. cervicaria* L. [15], *C. glomerata* L. [14, 15, 17], *C. grossekii* Heuff. [7], *C. lanata* Friv. [17], *C. moesiaca* Vel. [15, 17], *C. persicifolia* L. [5, 17], *C. rapunculoides* L. [8], *C. rapunculus* L. [14], *C. sibirica* L. [1, 4, 5], *C. sparsa* Friv. [15], *C. trachelium* L. [5, 8, 14, 15, 16, 17, 19], *C. transsilvanica* Schur ex Andrae [14], *Doronicum austriacum* Jacq. [15], *D. columnae* Ten. [14], *Euphrasia hirtella* Jord. ex Reud. [8], *E. liburnica* Wettst. [5], *E. minima* Jacq. ex DC. [15], *E. minima* x *rostkoviana* [14], *E. pectinata* Ten. [5, 14, 17], *E. picta* Wimm. subsp. *kernerii* (Wettst.) Yeo [8], *E. rostkoviana* Hayne [5, 14], *E. salisburgensis* Funck [14], *E. stricta* D. Wolff ex Lehm. [8, 15], *Inula aschersoniana* Janka [12, 18], *I. ensifolia* L. [17], *I. germanica* L. [19], *I. hirta* L. [5, 15], *I. salicina* L. subsp. *aspera* (Poir.) Hay. [19], *I. salicina* L. subsp. *salicina* [6], *Legousia speculum-veneris* (L.) Chaix [19], *Melampyrum cristatum* L. [16], *M. sylvaticum* L. [15], *Odontites serotina* (Lam.) Dum. [16], *Petasites albus* (L.) Gaertn. [15], *P. hybridus* (L.) Gaertn. [8, 15, 16], *P. kablikianus* Tausch ex Berch. [17], *Pinus mugho* Turra [15], *P. sylvestris* L. [5, 15], *Rhinanthus angustifolius* Gmel. [8], *R. rumelicus* Vel. [15], *R. wagneri* Deg. [15], *Senecio doria* L. [2], *S. doronicum* (L.) L. subsp. *glaberrimus* (Roch.) Kožuharov & N. Andr. [15], *S. nemorensis* L. subsp. *fuchsii* (C. Gmel.) Cel. [8], *S. nemorensis* L. subsp. *nemorensis* [14, 15, 16], *S. pancicii* Deg. [15], *S. sylvaticus* L. [5], *S. vernalis* W. & K. [17], *S. vulgaris* L. [11], *Senecio* sp. (cult.), *Sonchus arvensis* L. [2, 4, 19], *S. asper* (L.) Hill. [2, 15], *S. oleraceus* L. [5], *Telekia speciosa* (Schreb.) Baumg. [15], *Trachelium rumelianum* Hampe [12], *Tussilago farfara* L. [4, 5, 8, 15, 17]

CRONARTIUM FR.

16. *C. flaccidum* (Alb. & Schwein.) Winter

Gentiana asclepiadea L. [15, 17], *Paeonia peregrina* Mill. [15, 18], *Vincetoxicum hirundinaria* Med. [15]

17. *C. ribicola* J. C. Fischer

Ribes rubrum L. (cult.)

CUMMINIELLA ARTHUR

18. *C. mirabilissima* (Peck) Nannf.

Mahonia aquifolium (Pursh) Nutt. (cult.)

ENDOPHYLLUM LÉV.

19. *E. euphorbiae-sylvaticae* (DC.) Winter

Euphorbia amygdaloides L. [6, 15]

20. *E. sempervivi* (Alb. & Schwein.) de Bary

Jovibarba heuffelii (Schott) A. & D. Loeve [15], *Sempervivum marmoreum* Griseb. [7], *Sempervivum* sp. (cult.)

GYMNOSPORANGIUM R. HEDW. in DC.

21. *G. clavariiforme* (Wulfen : Pers.) DC.

Crataegus monogyna Jacq. [8, 15, 17], *Juniperus oxycedrus* L. [17], *Pyrus* sp. [8, 17], *Sorbus aucuparia* L.

22. *G. confusum* Plowr.

Cotoneaster integerrimus Medic. [8], *Crataegus monogyna* Jacq. [5], *Cydonia oblonga* Mill. (cult.), *Juniperus excelsa* Bieb. [10], *Mespilus germanica* L. (cult.), *Pyracantha coccinea* M. J. Roemer [20], *Pyrus sativa* Lam. & DC. (cult.)

23. *G. cornutum* Arthur ex Kern

Juniperus communis L. [8, 15], *Juniperus* sp. [14], *Sorbus aucuparia* L. [5, 8, 15, 17]

24. *G. gaeumannii* Zogg

Juniperus communis L. [16]

25. *G. gracile* Pat.

Juniperus oxycedrus L. [10]

26. *G. sabinae* (Dickson) Winter in Rabenh.

Juniperus sp., *Pyrus amygdaliformis* Vill. [14], *P. communis* L. (cult.)

27. *G. tremelloides* R. Hartig

Malus domestica Borkh. (cult.), *Sorbus aria* (L.) Crantz [15]

HYALOPSORA MAGNUS

28. *H. aspidiotus* (Magnus) Magnus*Gymnocarpium dryopteris* (L.) Newm. [15]**29. *H. polypodii* (Dietel) Magnus***Cystopteris alpina* (Lam.) Desv. [14], *C. fragilis* (L.) Bernh. [15, 17]**KUEHNEOLA MAGNUS****30. *K. uredinis* (Link) Arthur***Rubus caesius* L. [8], *R. glandulosus* Bell. [5, 15], *R. hirtus* W. & K. [15],*Rubus* sp. [1]**MELAMPSORA CASTAGNE****31. *M. allii-fragilis* Kleb.***Salix fragilis* L. [15, 17].**32. *M. allii-populina* Kleb.***Allium cepa* L. (cult.), *A. guttatum* Stev. subsp. *sardoum* (Moris) Stearn [1], *A. porrum* L. (cult.), *A. ursinum* L. [18], *Populus canadensis* Moench (cult.), *P. nigra* L. (cult.)**33. *M. amygdalinae* Kleb. in Pringsh.***Salix triandra* L. [15]**34. *M. apocyni* Tranzschel***Trachomitum venetum* (L.) Woods. [1]**35. *M. caprearum* Thüm.***Salix caprea* L. [8, 11, 15], *S. cinerea* L. [8]**36. *M. epitea* Thüm.***Salix arbuscula* L. [8], *S. caprea* L. [2, 8, 14, 15, 17], *S. elaeagnos* Scop. [17], *S. herbacea* L. [15], *S. purpurea* L. [7, 14, 15], *S. reticulata* L. [14], *S. retusa* L. [15], *Saxifraga pedemontana* All. subsp. *cymosa* (W. & K.) Engl. [14]**37. *M. euphorbiae* (Schubad) Castagne***Euphorbia agraria* L. [1, 2, 18], *E. amygdaloides* L. [8, 14, 15, 17], *E. barrellieri* Savi subsp. *thessala* (Form.) Bornm. [11], *E. cyparissias* L. [8, 15], *E. esula* L. subsp. *tommasiniana* (Bert.) Nym. [2], *E. falcata* L. [7, 12], *E. helioscopia* L. [2, 4, 10, 17, 19], *E. nicaeensis* All. [1, 2, 19], *E. paralias* L. [1], *E. peplus* L. [14], *E. plathyphyllos* L. [5], *E. polychroma* Kern. [12, 15], *E. salicifolia* Host [17], *E. seguerana* Neck. [2, 15], *E. serrulata*

Thuill. [5, 14, 15, 20], *E. taurinensis* All. [10, 17, 19], *E. velenovskyi* Bornm. [6, 14, 17, 18, 19]

38. *M. gelmii* Bresad.

Euphorbia falcata L.

39. *M. hypericorum* Winter in Rabenh.

Hypericum androsaemum L. [20], *H. calycinum* L. [20], *H. cerastoides* (Spach) N. Robson [17], *H. degenii* Bornm. [8], *H. montbretii* Spach [15], *H. olympicum* L. [11, 12], *H. perforatum* L. [5, 8, 16, 20], *H. richerii* Vill. [5, 8, 15], *H. rumeliacum* Boiss. [7]

40. *M. lapponum* Lindf.

Salix lapponum L. [8]

41. *M. larici-populina* Kleb.

Populus balsamifera L. (cult.), *P. pyramidalis* Rozan. (cult.)

42. *M. lini* (Ehrenb.) Desm.

Linum bienne Mill. [1, 19], *L. capitatum* Kit. ex Schult. [14, 15], *L. catharticum* L. [12, 15], *L. corymbulosum* Rchb. [1], *L. nervosum* W. & K. [1], *L. nodiflorum* L. [17], *L. tauricum* Willd. [18], *L. trigynum* L. [17], *L. usitatissimum* L. (cult.)

43. *M. populnea* (Pers. : Pers.) P. Karsten

Mercurialis annua L. [5], *M. ovata* Sternb. & Hoppe [1], *Pinus sylvestris* L. [8], *Populus alba* L. [17], *P. nigra* L. [18], *P. tremula* L. [8, 15]

44. *M. salicis-albae* Kleb.

Salix alba L. [4, 6, 15]

45. *M. vernalis* Niessl ex Winter in Rabenh.

Saxifraga adscendens L. subsp. *discolor* (Vel.) Kuzm. [14, 15], *S. exarata* Vill. subsp. *pirinica* (S. Pawl.) Kuzm. [15], *S. pedemontana* All. subsp. *cymosa* (W. & K.) Engl. [14, 15]

MELAMPSORELLA SCHRÖTER

46. *M. caryophyllacearum* Schröter

Abies alba Mill. [8, 15], *Stellaria holostea* L. [15], *S. nemorum* L. [16]

47. *M. symphyti* Bubák

Abies alba Mill. [15], *Symphytum bulbosum* Schim. [15], *S. officinale* L. [1], *S. ottomanum* Friv. [17], *S. tuberosum* L. [15]

MELAMPSORIDIUM KLEB.

48. *M. betulinum* Kleb.*Betula pendula* Roth [15]**MILESINA MAGNUS****49. *M. dieteliana* (Sydow & H. Sydow) Magnus***Polypodium vulgare* L. [15]**50. *M. scolopendrii* (Arthur ex Faull) D. M. Henders.***Phyllitis scolopendrium* (L.) Newm. [20]**MIYAGIA MIYABE in H. SYDOW & SYDOW****51. *M. pseudosphaeria* (Mont.) Jørstad***Sonchus arvensis* L. subsp. *arvensis* [4], *S. arvensis* L. subsp. *uliginosus* (Bieb.) Nym. [18], *S. asper* (L.) Hill [1, 6, 8], *S. oleraceus* L. [18], *S. palustris* L. [1]**NYSSOPSORA ARTHUR****52. *N. echinata* (Lév.) Arthur***Ligusticum mutellina* (L.) Crantz [15]**OCHROPSORA DIETEL****53. *O. ariae* (Fuckel) Ramsb.***Anemone pavonina* Lam. [1, 10], *A. ranunculoides* L. [8]**PHRAGMIDIUM LINK****54. *Ph. acuminatum* (Fr.) Cooke***Rubus saxatilis* L. [14]**55. *Ph. bulbosum* (Str.) Schlecht.***Rubus caesius* L. [2, 4, 5, 6, 11, 16, 17], *R. glandulosus* Bell. [17], *R. hirtus* W. & K. [15], *R. thyrsanthus* Focke [15]**56. *Ph. fragariae* (DC.) Rabenh.***Potentilla alba* L. [6], *P. micrantha* Ramond ex DC. [4, 5, 8, 15, 16, 17], *P.*

patula W. & K. [11]

57. *Ph. fusiforme* Schröter

Rosa gallica L. [8], *R. glutinosa* S. & S. [11], *R. pendulina* L. [15]

58. *Ph. mucronatum* (Pers. : Pers.) Schlecht.

Rosa arvensis Huds. [17], *R. caesia* Sm. in Sow. [15], *R. canina* L. [5, 15, 17], *R. centifolia* L. (cult.), *R. corymbifera* Borkh. [4, 5, 8, 15, 17], *R. damascena* Mill. f. *trigintipetala* Dieck (cult.), *R. micrantha* Borrer ex Sm. in Sow. [5], *R. tomentosa* Sm. [15], *Rosa* spp. (cult.), *Rosa* spp. (spont.) [2, 5, 11, 16, 18]

59. *Ph. potentillae* (Pers. : Pers.) P. Karsten

Potentilla argentea L. [8, 15, 16], *P. cinerea* Chaix ex Vill. [4, 7, 16], *P. crantzii* (Crantz) Beck ex Fritsch [3], *P. inclinata* Vill. [18], *P. laciniosa* W. & K. ex Nestler [15, 17], *P. neglecta* Baumg. [14, 18], *P. sulphurea* Lam. (cult.), *P. ternata* C. Koch [14, 15]

60. *Ph. sp. aff. rosae-pimpinellifoliae* Dietel

Rosa sp. (cult.), *Rosa* sp. (spont.) [17]

61. *Ph. rubi-idaei* (DC.) P. Karsten

Rubus idaeus L. [8, 14, 15, 16]

62. *Ph. sanguisorbae* (DC.) Schröter

Sanguisorba minor Scop. [5]

63. *Ph. tuberculatum* J. Müller

Rosa agrestis Savi [17], *R. arvensis* Huds. [10], *R. canina* L. [15, 17], *R. corymbifera* Borkh. [3, 4, 5], *R. gallica* L. [14], *R. glutinosa* S. & S. [12, 14], *R. micrantha* Borrer ex Sm. in Sow. [7, 12], *R. myriacantha* DC. ex Lam. & DC. [17], *R. tomentosa* Sm. [7], *R. vosagiaca* Desp. [5]

64. *Ph. violaceum* (C. Schultz) Winter

Rubus caesius L. [2, 5, 14, 17], *R. canescens* DC. [19], *R. discolor* Weihe & Nees [10, 14], *R. hirtus* W. & K. [14, 20], *R. macrostachys* Mueller [5], *R. sanguineus* Friv. [14], *R. thyrsanthus* Focke [5, 15]

****Phragmidium* sp.**

Rosa foetida Herrmann (cult.)

***PILEOLARIA* CASTAGNE**

65. *P. terebinthi* Castagne

Pistacia terebinthus L. [17]

PUCCINIA PERS. : PERS.

66. *P. absinthii* (R. Hedw.) DC. (s. Ono & Kakishima, 1992)
Artemisia abrotanum L. (cult.), *A. absinthium* L. [4, 5, 18], *A. campestris* L. [1], *A. maritima* L. [1], *A. vulgaris* L. [4, 8, 12]

67. *P. acarnae* Sydow & H. Sydow

Picnomon acarna (L.) Cass. [2]

68. *P. acetosae* Körn.

Rumex acetosa L. [1], *R. acetosella* L. [11, 15], *R. arifolius* All. [8, 15], *R. crispus* L. [5], *R. pulcher* L. [10], *R. sanguineus* L. [14]

69. *P. achilleae* Cooke

Achillea coarctata Poir. [10]

70. *P. adoxae* R. Hedw.

Adoxa moschatellina L. [15]

71. *P. aegopodii* (Schumacher) Röhl.

Aegopodium podagraria L. [8, 15]

72. *P. allii* Rudolphi

Allium (?) *atroviolaceum* Boiss. [1, 15], *A. carinatum* L. [15, 18], *A. cepa* L. (cult.), *A. flavum* L. var. *minus* Boiss. [5], *A. guttatum* Stev. subsp. *sardoum* (Moris) Stearn [1, 6], *A. oleraceum* L. [19], *A. paniculatum* L. [18, 19], *A. porrum* L. (cult.), *A. rotundum* L. [10], *A. sativum* L. (cult.), *A. schoenoprasum* L. [6, 7], *A. scorodoprasum* L. [7, 15], *A. vineale* L. [1]

73. *P. alpina* Fuckel

Viola biflora L. [14, 15]

74. *P. angelicae* (Schumacher) Fuckel

Angelica sylvestris L. [15], *Peucedanum aegopodioides* (Boiss.) Vand. [8], *P. alsaticum* L. [2, 8, 17], *P. arenarium* W. & K. [1], *P. austriacum* (Jacq.) Koch [7, 14, 15, 17]

75. *P. annularis* (Str.) Röhl.

Teucrium chamaedrys L. [4, 6, 14, 15, 17]

76. *P. antirrhini* Dietel & Holway

Antirrhinum majus L. (cult.)

77. *P. arenariae* (Schumacher) Winter

Arenaria serpyllifolia L. [4], *Herniaria incana* Lam. [4], *Moehringia muscosa* L. [5, 7, 9], *M. pendula* (W. & K.) Fenzl. [14], *M. trinervia* (L.) Clairv. [14, 15], *Myosoton aquaticum* (L.) Moench. [15], *Sagina procumbens* L. [16], *S. saginoides* (L.) Karst. [5], *Silene heuffelii* Soo [14], *Silene* sp. [15], *Stellaria graminea* L. [5, 15], *S. holostea* L. [15], *S. media* (L.) Vill. [6, 17],

S. nemorum L. [11, 15]

78. *P. aristolochiae* (DC.) Winter

Aristolochia macedonica Bornm. [15]

79. *P. artemisiae-camphoratae* Guyot

Artemisia alba Turra [7]

80. *P. asarina* Kunze

Asarum europaeum L. [14, 15]

81. *P. artemisiicola* Sydow & H. Sydow

Artemisia vulgaris L. [16]

82. *P. asparagi* DC.

Asparagus officinalis L. (cult.)

83. *P. asperulae-cynanchicae* Wurth

Asperula aristata L. f. [12, 14], *A. cynanchica* L. [1], *A. tenella* Heuff. ex Deg. [4]

84. *P. asphodeli* Moug. ex Duby

Asphodelus albus Mill. [8]

85. *P. atragenes* Hausm.

Clematis alpina (L.) Mill. [15]

86. *P. australis* Körn.

Diplachne serotina (L.) Link [10]

87. *P. azerbaijanschanica* Tranzschel & Erem.

Seseli peucedanoides (M.B.) Kos.-Poljan. [17]

88. *P. balsamitae* (Str.) Röhl.

Tanacetum balsamita L. (cult.)

89. *P. behenis* Otth

Silene vulgaris (Moench) Garcke [1, 2]

90. *P. betonicae* (Alb. & Schwein.) DC.

Stachys officinalis (L.) Trev. [8]

91. *P. bistortae* DC.

Bistorta major S. Gray [5, 15]

92. *P. brachypodii* Otth s. lat.

Arrhenatherum elatius (L.) Beauv. ex J. & C. Presl. [4], *Brachypodium pinnatum* (L.) Beauv. [4, 5, 17, 20], *B. sylvaticum* (Huds.) Beauv. [17], *Deschampsia caespitosa* (L.) Beauv. [14, 15], *Milium effusum* L. [15], *Piptatherum virescens* (Trin.) Boiss. [2], *Poa annua* L. [15], *P. chaixii* Vill. [15]

93. *P. bupleuri* Rudolphi

Bupleurum affine Sadl. [5, 19], *B. apiculatum* Friv. [2, 18, 19], *B.*

asperuloides Heldr. ex Boiss. [10], *B. commutatum* Boiss. & Balansa [12, 14, 19], *B. falcatum* L. [8, 17], *B. flavum* Forsk. [17, 19], *B. fontanesii* Guss. [19], *B. praealtum* L. [15], *B. rotundifolium* L. [2, 18], *B. sibthorpiatum* Sm. [17]

94. *P. calcitrapae* DC.

Arctium lappa L. [8, 15, 19], *A. tomentosum* Mill. [17], *Carduus crispus* L. [2, 8, 16], *C. kernerii* Simonk. subsp. *austro-orientalis* Franco [8, 15], *C. nutans* L. [16, 19], *C. personata* (L.) Jacq. [5, 15], *C. pycnocephallus* L. [1, 17], *Carlina acanthifolia* All. [7], *C. vulgaris* L. [5, 8, 12, 17], *Centaurea affinis* Friv. [5, 17], *C. arenaria* Bieb. ex Willd. [1], *C. calcitrapa* L. [1], *C. chrysolepis* Vis. [4], *C. diffusa* Lam. [4], *C. iberica* Trev. ex Spreng. [6], *C. immanuelis-loewii* Deg. [10], *C. indurata* Janka [8], *C. jacea* L. [8, 17, 19], *C. kernerana* Janka subsp. *gheorghieffii* (Hal.) Dost. [15], *C. mannagettae* Podp. [14], *C. (?) nigrescens* Willd. [15], *C. pannonica* (Heuff.) Simk. [6], *C. parilica* Stoj. [12], *C. phrygia* L. subsp. *moesiaca* (Urum. & Wagn.) Hay. [8, 15], *C. phrygia* L. subsp. *phrygia* [6, 15], *C. rhenana* Boreau [15, 16], *C. rutifolia* S. & Sm. [4], *C. salonitana* Vis. [7], *C. scabiosa* L. [16, 17, 18], *C. solstitialis* L. [1], *C. splendens* L. [1, 5], *C. stenolepis* A. Kern. subsp. *razgradensis* (Vel.) Stoj. & Acht. [8], *C. stenolepis* A. Kern subsp. *stenolepis* [17], *C. thracica* (Janka) Hay. [18], *C. triumphettii* All. [2], *C. uniflora* Turra subsp. *nervosa* (Willd.) Bonn. & Layens [4, 8], *Cirsium appendiculatum* Griseb. [14, 15, 16], *C. arvense* (L.) Scop. [2], *C. canum* (L.) All. [1, 2], *C. creticum* (Lam.) D'Urv. [1], *C. heterotrychum* Panc. [8], *C. ligulare* Boiss. [16], *C. oleraceum* (L.) Scop. [5], *C. siculum* Spreng. [3, 16, 18, 20], *Echinops banaticus* Roch ex Schrad. [4, 5, 8], *E. microcephalus* S. & S. [15], *E. ritro* L. [12], *E. sphaerocephalus* L. subsp. *albidus* (Boiss. & Sprun.) Kožuharov [15], *E. sphaerocephalus* L. subsp. *sphaerocephalus* [15], *Jurinea albicaulis* Bunge subsp. *kilaea* (Azn.) Kožuharov [1], *J. mollis* (L.) Rechb. subsp. *anatolica* (Boiss.) Stoj. & Stef. [14], *Serratula tinctoria* L. [19]

95. *P. calthae* Link

Caltha laeta Schott, Nym. & Kotschy [8], *C. palustris* agr. (non *C. palustris* L.) [15]

96. *P. calthicola* Schröter

Caltha palustris agr. (non *C. palustris* L.) [8]

97. *P. campanulae* Carm. ex Berk.

Campanula expansa Friv. [18], *C. rotundifolia* L. [14]

98. *P. cancellata* (Durieu & Mont.) Sacc. & Roum.

Juncus acutus L. [1]

99. *P. caricina* DC.

Carex acuta L. [15, 20], *C. distachya* Desf. [17], *C. divulsa* Stokes in With. subsp. *pairaei* (F. M. Schul.) Cel. [15], *C. echinata* Murr. [15], *C. flacca* Schreb. [5, 17], *C. hirta* L. [16], *C. hordeistichos* Vill. [1, 7], *C. nigra* (L.) Rchb. [15, 17], *C. pallescens* L. [17], *C. pendula* Huds. [4, 8], *C. pilosa* Scop. [8], *C. riparia* Curt. [18], *Ribes alpinum* L. [15], *Urtica dioica* L. [5, 8], *U. urens* L. [2]

100. *P. carniolica* W.Voss

Peucedanum carvifolium Vill. [5]

101. *P. caucasica* Savelli

Iris pumila L. [1], *I. variegata* L. [7]

102. *P. cesatii* Schröter

Dichanthium ischaemum (L.) Roberty [4, 6, 15, 17]

103. *P. chaerophylli* Purton

Anthriscus cerefolium (L.) Hoffm. [18], *Chaerophyllum aureum* L. [14, 15], *Ch. bulbosum* L. [3, 8, 17], *Ch. hirsutum* L. [8], *Ch. temulentum* L. [3]

104. *P. chrysanthemi* Roze (s. Ono & Kakishima, 1992)

Chrysanthemum sp. (cult.)

105. *P. chrysosplenii* Grev.

Chrysosplenium alternifolium L. [15]

106. *P. circaeae* Pers. : Pers.

Circaea lutetiana L. [5, 16]

107. *P. cladii* Ell. & Tracy

Cladium mariscus (L.) Pohl [1]

108. *P. cnici* Mart.

Cirsium bulgaricum DC. [1], *C. creticum* (Lam.) D'Urv. [1], *C. italicum* (Savi) DC. [17, 20], *C. ligulare* Boiss. [14, 15], *C. vulgare* (Savi) Ten. [4, 5, 8, 15, 16, 17]

109. *P. cnici-oleracei* Pers. ex Desm.

Achillea clypeolata S. & S. [2], *A. millefolium* L. [2, 6, 11, 15], *Artemisia austriaca* Jacq. [1], *Centaurea salonitana* Vis. [1, 19], *Cirsium appendiculatum* Griseb. [8, 15, 17]

110. *P. cnidii* Lindr.

Cnidium silaifolium (Jacq.) Simk. [2]

111. *P. coaetanea* Bubák

Galium glaucum L. [1, 2, 4, 17]

112. *P. conclusa* Thüm.

Pycnus longus (L.) Hay. [1]

113. *P. conglomerata* (Str.) Röhl.*Homogyne alpina* (L.) Cass. [15]**114. *P. conii* Fuckel ex Lagerh.***Conium maculatum* L. [14, 19]**115. *P. constricta* (Lagerh.) Bubák***Teucrium montanum* L. [5, 14]**116. *P. convolvuli* Castagne***Calystegia sepium* (L.) R. Br. [4, 5, 12, 17, 18], *Convolvulus arvensis* L. [2]**117. *P. coronata* Corda***Agrostis capillaris* L. [2, 15], *A. stolonifera* L. [1, 5, 8, 14], *Alopecurus geniculatus* L. [2], *A. myosuroides* Huds. [2], *A. pratensis* L. [2], *Arrhenatherum elatius* (L.) Beauv. ex J. & C. Presl [4], *Avena barbata* Pott ex Link [1], *A. fatua* L. [2, 3, 4], *A. sativa* L. (cult.), *Avenula pubescens* (Huds.) Dum. [16], *Brachypodium sylvaticum* (Huds.) Beauv. [15], *Bromus inermis* Leyss. [1], *B. tectorum* L. [3], *Calamagrostis arundinacea* (L.) Roth [5], *C. pseudophragmites* (Hall. f.) Koel. [1], *Cynodon dactylon* (L.) Pers. [4], *Dactylis glomerata* L. [15], *Elymus repens* (L.) Gould. [2, 3], *Festuca pratensis* Huds. [2], *F. rubra* L. [5], *Frangula alnus* Mill. [14, 17], *Holcus lanatus* L. [6, 8, 15], *Lolium multiflorum* Lam. [14], *L. perenne* L. [2], *Phalaris paradoxa* L. [1], *Rhamnus catharticus* L. [6, 18], *R. saxatilis* Jacq. [7, 17], *Sesleria latifolia* (Adam.) Deg. [5]**118. *P. crepidicola* H. Sydow & Sydow***Crepis foetida* L. [1], *C. pulchra* L. [17], *C. setosa* Hall. f. [3, 6, 14]**119. *P. crepidis* Schröter in Cohn***Crepis biennis* L. [8, 15, 18], *C. bithynica* Boiss. [14], *C. capillaris* (L.) Wallr. [6], *C. foetida* L. [1, 7, 10, 14, 17, 18, 19], *C. setosa* Hall. f. [4, 5, 10, 14, 17, 19]**120. *P. crepidis-grandiflorae* Hasler***Crepis conyzifolia* (Gouan) A. Kern. [15], *C. viscidula* Froel. [5, 12, 15]**121. *P. crocii* Gäum. & Terrier***Crocus biflorus* Mill. [16], *C. chrysanthus* (Herb.) Herb. [2], *C. flavus* West. [17], *C. olivieri* J. Gay. [17, 19], *C. veluchensis* Herb. [8, 15], *Crocus* sp. [11]**122. *P. crucianellae* Desm.***Crucianella angustifolia* L. [18]**123. *P. cruciferarum* Rudolphi***Cardamine resedifolia* L. [15]**124. *P. crupinae* Ranojevič**

Crupina vulgaris Cass. [7, 17]

125. *P. cyani* Pass. in Rabenh.

Centaurea cyanus L. [18]

126. *P. cynodontis* Lacroix ex Desm.

Adonis flammea Jacq. [19], *Consolida orientalis* (J. Gay.) Schroed. [2], *Cynodon dactylon* (L.) Pers. [17, 18], *Plantago lanceolata* L. [19], *Viola kitaibeliana* Schult. [10, 17, 18, 19], *V. tricolor* L. [2, 4]

127. *P. dentariae* (Alb. & Schwein.) Fockel

Cardamine bulbifera (L.) Crantz [8]

128. *P. dictyoderma* Lindr.

Smyrnium perfoliatum L. [6, 8]

129. *P. difformis* Kunze in Kunze & Schm.

Galium aparine L. [18]

130. *P. dioicae* Magnus

Carex atrata L. [15], *C. ligerica* Gay [1], *C. nigra* (L.) Rchb. [5], *C. ovalis* Good. [2, 5], *C. sempervirens* Vill. [15], *Centaurea cyanus* L. [18], *C. jacea* L. [8], *C. kotschyana* Heuff. ex Koch [15], *C. napulifera* Roch. subsp. *thirkei* (Schultz-Bip.) Dost. [18, 19], *C. phrygia* L. [4, 8], *Cirsium* sp. [2], *Taraxacum erythrospermum* Andr. ex Bess. [2], *T. officinale* Web. [3]

131. *P. doronici* Niessl

Doronicum austriacum Jacq. [15], *D. columnae* Ten. [15]

132. *P. drabae* Rudolphi

Draba lasiocarpa Roch. [5, 7]

133. *P. dracunculina* Fehrend.

Artemisia dracunculus L. (cult.)

134. *P. epilobii* DC.

Epilobium (?) *obscurum* Schreb. [8]

135. *P. eryngii* DC. in Lam.

Eryngium campestre L. [1, 2, 8, 15, 17, 18]

136. *P. ferulae* Rudolphi

Ferulago campestris (Bess.) Grec. [19]

137. *P. festucae* Plowr.

Festuca arundinacea Schreb. [1], *F. heterophylla* Lam. [15], *Lonicera coerulea* L. [15], *L. nigra* L. [8], *L. xylosteum* L. [15]

138. *P. frankeniae* Link

Frankenia pulverulenta L. [1]

139. *P. galii-vernii* Ces. in Klotzsch

Cruciata glabra (L.) Ehrend. [5, 8, 14, 15], *C. laevipes* Opiz [4, 5, 6]

140. *P. gentianae* (Str.) Röhl.

Gentiana cruciata L. [7, 15]

141. *P. gigantea* P. Karsten

Epilobium angustifolium L. [15]

142. *P. gladioli* (Requien) Castagne

Gladiolus imbricatus L. [7, 16, 17, 19], *G. italicus* Mill. [18], *Valerianella coronata* (L.) DC. [6, 8]

143. *P. glechomatis* DC. ex Poir. in Lam.

Glechoma hederacea L. [4, 5, 6, 11], *G. hirsuta* W. & K. [6, 15]

144. *P. globulariae* DC.

Globularia aphyllanthes Crantz [7]

145. *P. glomerata* Grev.

Senecio doronicum (L.) L. subsp. *glaberrimus* (Roch.) Kožuharov & N. Andr. [14, 15], *S. pancicii* Deg. [8]

146. *P. graminis* Pers. : Pers.

Agropyron brandzae Pantu & Solac. [2], *A. cristatum* (L.) Gaertn. [1], *Agrostis capillaris* L. [19], *A. verticillata* Vill. [1], *Alopecurus myosuroides* Huds. [11], *A. pratensis* L. (cult.), *Anthoxanthum odoratum* L. [15], *Avena abyssinica* Hochst. ex Rich. (cult.), *A. barbata* Pott ex Link [1], *A. fatua* L. [2, 18], *A. sativa* L. (cult.), *A. strigosa* Schreb. (cult.), *Avenula pubescens* (Huds.) Dum. [16], *Berberis vulgaris* L. [2, 6, 17, 18], *Brachypodium sylvaticum* (Huds.) Beauv. [5], *Briza media* L. [1], *Bromus inermis* Leyss. [15], *Calamagrostis arundinacea* (L.) Roth [15], *C. epigejos* (L.) Roth [2], *Chrysopogon gryllus* (L.) Trin [19], *Cynodon dactylon* (L.) Pers. [6], *Cynosurus cristatus* L. [5], *Dactylis glomerata* L. [15], *Elymus caninus* (L.) L. [5], *E. elongatus* (Host) Greut. [1], *E. hispidus* (Opiz) Meld. [2], *E. repens* (L.) Gould. [6], *Festuca gigantea* (L.) Vill. [15, 16], *F. pratensis* Huds. [2, 5, 15, 16], *Festuca* sp. [2], *Hordeum murinum* L. [15], *H. vulgare* L. (cult.), *Hordeum* sp. [6, 15], *Hordelymus europaeus* (L.) Harz [5, 15], *Lolium multiflorum* Lam. [3], *L. perenne* L. [15, 18], *L. temulentum* L. [17], *Mahonia aquifolium* (Pursh) Nutt (cult.), *Phleum alpinum* L. (cult.), *Ph. pratense* L. [6], *Ph. subulatum* (Savi) A. & G. [1, 17], *Phragmites australis* (Cav.) Trin. ex Steud. [1, 7, 14, 15], *Poa alpina* L. [5], *P. bulbosa* L. [10], *P. compressa* L. [16], *P. pratensis* L. [5], *P. trivialis* L. [14], *Psilurus incurvus* (Gouan) Schinz & Thell. [19], *Secale cereale* L. (cult.), *S. sylvestre* Host [1], *Taeniatherum caput-medusae* (L.) Nevski [15], *Triticum aestivum* L. (cult.), *T. baeticum* Boiss. [4] *T. durum* Desf. (cult.), *T. monoccocum* L. (cult.), *T. turgidum* L. (cult.)

147. *P. helianthi* Schwein.

Helianthus agrophyllus Judh. (cult.), *H. annuus* L. (cult.), *H. chinensis* Melnhof. (cult.), *H. tuberosus* L. (cult.)

148. *P. helvetica* Schröter

Asperula taurina L. [4]

149. *P. heraclei* Grev.

Heracleum sibiricum L. [19]

150. *P. hieracii* (Röhl.) Mart.

Centaurea affinis Friv. [12, 18], *C. diffusa* Lam. [12], *C. jacea* L. [17], *C. parilica* Stoj. & Stef. [12], *C. phrygia* L. [5, 8], *C. rhenana* Boreau [5, 8], *C. rutifolia* S. & Sm. [17], *C. salonitana* Vis. [1, 7, 12], *C. scabiosa* L. [4, 6, 14, 15, 17], *C. solstitialis* L. [6, 7, 10, 18], *C. stenolepis* A. Kern. [15, 17], *C. uniflora* Turra subsp. *nervosa* (Willd.) Bonn. & Layens [5, 14], *Chondrilla juncea* L. [6, 18], *Cichorium intybus* L. [5, 15], *Doronicum austriacum* Jacq. [15], *D. columnae* Ten. [15], *Hieracium alpicola* Schl. ex Gaud. [15], *H. argillaceum* gr. [8, 15], *H. bifidum* gr. [5], *H. cymosum* L. [15, 18], *H. djimilense* Boiss. & Bal. [8], *H. florentinum* All. [5, 6, 17, 20], *H. hoppeanum* Schult. [15], *H. murorum* gr. [15, 17], *H. pannosum* Boiss. [14, 17], *H. pilosella* L. [8, 17], *H. praealtum* Vill. ex Goch. [8], *H. racemosum* W. & K. [8, 16], *H. robustum* Fries [15], *H. sabaudum* L. [8], *H. sparsum* Friv. [15], *H. umbellatum* L. [14, 17], *H. villosum* L. [5], *Leontodon cichoraceus* (Ten.) Sanguin. [1, 20], *L. crispus* Vill. [5, 7, 14], *L. hispidus* L. subsp. *danubialis* (Jacq.) Simonk. [5, 6, 8], *L. hispidus* L. subsp. *hispidus* [5], *L. rilaensis* Hay. [14, 15], *Picris hieracioides* L. [4], *P. pauciflora* Willd. [11, 17], *P. sprengeriana* (L.) Poir. [1, 10, 14, 17], *Scolymus hispanicus* L. [1, 10, 19], *S. maculatus* L. [1], *Taraxacum bessarabicum* (Hornem.) Hand.-Mazz. [1, 19], *T. bithynicum* DC. [14, 15], *T. erythrospermum* Andr. ex Bess. [7], *T. officinale* Web. [2, 5, 6, 15, 18], *T. serotinum* (W. & K.) Poir. [5, 18]

151. *P. holophaea* H. Sydow

Heptaptera triquetra (Vent.) Tutin [1]

152. *P. hordei* Otth

Holcus mollis L. [8, 15, 16, 17], *H. lanatus* L. [5, 8, 14, 20], *Hordelymus europaeus* (L.) Harz [8, 20], *Hordeum bulbosum* L. [1, 4, 18, 19], *H. hystrix* Roth [18], *H. murinum* L. [2, 3, 4, 6], *H. vulgare* L. (cult.), *Koeleria* spp. [11, 19], *Lolium temulentum* L. [19], *Ornithogalum fimbriatum* Willd. [18], *O. kochii* Parl. subsp. *kochii* [1], *O. refractum* Kit. ex Schlecht. [1], *O. umbellatum* L. [2], *Vulpia myurus* (L.) C. C. Gmel. [15, 17]

153. *P. hypchoeridis* Oudem.

Hypochaeris glabra L. [1], *H. maculata* L. [5, 15], *H. radicata* L. [6]

154. *P. hysteriorum* (Str.) Röhl.*Tragopogon pratensis* L. [6, 15]**155. *P. impatientis* Schubad***Adoxa moschatellina* L. [15], *Impatiens noli-tangere* L. [15]**156. *P. iridis* Wallr. in Rabenh.***Iris bucharica* Fost. (cult.), *I. chrysographes* Dykes (cult.), *I. ensata* Thunb. (cult.), *I. germanica* L. (cult.), *I. graminea* L. (cult.), *I. halophylla* Pall. (cult.), *I. livida* Booth. (cult.), *I. monnieri* DC. (cult.), *I. ochroleuca* L. (cult.), *I. sibirica* L. (cult.)**157. *P. isiacae* Winter in Kuntze***Cardaria draba* (L.) Desv. [1], *Ligustrum vulgare* L. [2]**158. *P. istriaca* Sydow & H. Sydow***Teucrium polium* L. [17]**159. *P. imperatae* Poirault***Imperata cylindrica* (L.) Beauv. [10]**160. *P. imperatoriae* Jacky***Peucedanum alsaticum* L. [18]**161. *P. jasminii* DC.***Jasminum fruticans* L. [10, 17]**162. *P. jordanovii* Hinkova***Carum graecum* Boiss. & Heldr. [14]**163. *P. lactucarum* H. Sydow & Sydow***Lactuca perennis* L. [17], *L. quercina* L. [5, 17], *Mycelis muralis* (L.) Dum. [5, 14], *Steptorhamphus tuberosus* (Jacq.) Grossh. [17]**164. *P. lagenophorae* Cooke***Senecio vernalis* W. & K. [10]**165. *P. lapsanae* Fockel***Lapsana communis* L. [2, 4, 5, 8, 11, 15, 16, 17]**166. *P. libani* Magnus***Stefanoffia daucooides* (Boiss.) H. Wolff [18]**167. *P. libanotidis* Lindr.***Seseli libanotis* (L.) Koch [5]**168. *P. liliacearum* Duby***Ornithogalum* (?) *montanum* Cyr. [2], *O. sibthorpii* Greut. [8], *O. umbellatum* L. [4, 5]**169. *P. limosae* Magnus***Lysimachia atropurpurea* L. [19]**170. *P. littoralis* Rostrup**

Juncus gerardii Loisel. [1]

171. *P. ljulinica* Hinkova & Koeva

Smyrniium perfoliatum L. [8]

172. *P. lojkaiana* Thüm.

Ornithogallum nutans L. [17]

173. *P. longissima* Schröter

Koeleria macrantha (Ledeb.) Schult. & Schult f. [1, 4, 7, 10, 16, 17],

Sedum sp. [17]

174. *P. luzulae* Lib.

Luzula campestris (L.) DC. [15], *L. luzuloides* (Lam.) Dandy [15]

175. *P. lycoctoni* Fuckel

Aconitum lycoctonum L. subsp. *neapolitanum* (Ten.) Nym. [15]

176. *P. maculosa* (Str.) Röhl.

Cicerbita alpina (L.) Wallr. [15], *Lactuca aurea* (Schultz-Bip. ex. Panc.)

Steb. [5], *Mycelis muralis* (L.) Dum. [8, 15, 16], *Prenanthes purpurea* L.

[5, 8, 15, 17]

177. *P. magnusiana* Körn.

Phragmites australis (Cav.) Trin. ex Steud. [1, 6, 18]

178. *P. major* (Dietel) Dietel

Crepis biennis L. [8, 15], *C. dobrogica* Babc. [19], *C. paludosa* (L.) Moench

[15], *C. pulchra* L. [5], *C. schachtii* Babck. [12]

179. *P. malvacearum* Bert. in Mont.

Alcea heldreichii (Boiss.) Boiss. [18], *A. pallida* (W. & K. ex Willd.) W.

& K. [2, 10], *A. rosea* L. [1, 2, 5, 6, 15, 18], *Althaea armeniaca* Tenore

(cult.), *A. ficifolia* Cav. (cult.), *A. hirsuta* L. [2, 3], *A. officinalis* L. [2, 6],

Malva arborea A. St. (cult.), *M. moschata* L. [4], *M. neglecta* Wallr. [5, 14,

15], *M. pusilla* Sm. [1, 6, 17], *M. sylvestris* L. [1, 2, 4, 5, 6, 10, 11, 15, 18, 19]

180. *P. martianoffiana* Thüm.

Paeonia peregrina Mill. [7]

181. *P. menthae* Pers. : Pers.

Acinos alpinus (L.) Moench subsp. *hungaricus* (Simk.) Sojak [4], *A.*

alpinus (L.) Moench subsp. *meridionalis* (Nym.) Ball [15], *Calamintha*

grandiflora (L.) Moench [5, 14], *C. nepeta* (L.) Savi [5], *C. sylvatica* Bromf.

[4, 5, 15], *Clinopodium vulgare* L. [8, 11, 14, 15], *Melissa officinalis* L. [4],

Mentha aquatica L. [5, 8, 14], *M. arvensis* L. [17], *M. longifolia* (L.) Huds.

[4, 5, 6, 8, 14, 15, 16, 17], *M. piperita* L. (cult.), *M. pulegium* L. [15, 18],

M. spicata L. [1, 3, 4, 16], *Micromeria cristata* (Hampe) Griseb. [12], *M.*

dalmatica Benth. subsp. *bulgarica* (Vel.) Guinea [12, 17], *M. frivaldszkyana*

(Deg.) Vel. [5], *Origanum vulgare* L. [2, 4, 5, 15], *Satureja coerulea* Janka

[12, 16], *S. cuneifolia* Ten. [12, 14], *S. montana* L. subsp. *kitaibelii* (Wierzb. ex Heuff.) Ball [5]

182. *P. minussensis* Thüm.

Lactuca tatarica (L.) C. A. Mey. [1]

183. *P. molinae* Tul.

Molinia coerulea (L.) Moench [18]

184. *P. montana* Fuckel

Centaurea napulifera Roch. subsp. *thirkei* (Schultz-Bip.) Dost. [18], *C. salonitana* Vis. [19], *Centaurea* sp. [14]

185. *P. morthieri* Körn.

Geranium sylvaticum L. [8, 15]

186. *P. mougeotii* Lagerh.

Thesium arvense Horvatov. [7, 8, 15], *T. dollineri* Murb. [2, 4, 18]

187. *P. nigrescens* Kirchner

Salvia verticillata L. [4, 5, 6, 15, 17]

188. *P. nitida* (Str.) Röhl.

Anethum graveolens L. [18], *Seseli annuum* L. [1, 19], *S. degenii* Urum. [4], *S. pallasii* Bess. [10], *S. rhodopeum* Vel. [4, 17], *S. tortuosum* L. [1]

189. *P. nitidula* Tranzschel in Tranzschel & Serebr.

Pleuropterypyrum undulatum (A. Murr.) A. & D. Loeve [15]

190. *P. obscura* Schröt. in Pass.

Bellis perennis L. [2], *Luzula campestris* (L.) DC. [5, 17], *L. forsteri* (Sm.) DC. [5, 14, 20], *L. luzulina* (Vill.) D.T. & Sarnth. [14], *L. luzuloides* (Lam.) Dandy [17], *L. sudetica* (Willd.) DC. [15] *L. sylvatica* (Huds.) Gaud. [14, 15]

191. *P. oerteliana* Tranzschel

Geranium sanguineum L. [7, 17]

192. *P. opizii* Bubák

Carex acutiformis Ehrh. [5], *C. muricata* L. [15], *Crepis biennis* L. [19], *C. pulchra* L. [19], *Lactuca sativa* L. (cult.), *L. serriola* L., *Lapsana communis* L. [3, 4, 19], *Mycelis muralis* (L.) Dum. [5, 8, 15], *Senecio vulgaris* L. [6]

193. *P. opoponacis* Ces.

Opoponax chironium (L.) Koch subsp. *bulgaricum* (Vel.) N. Andr. [1], *O. hispidum* (Friv.) Griseb. [18, 19]

194. *P. oreoselini* (Str.) Fuck.

Peucedanum aegopodioides (Boiss.) Vand. [5, 8, 14]

195. *P. oxyriae* Fuckel

Oxyria digyna (L.) Hill. [14]

196. *P. pachyphloea* Sydow & H. Sydow*Rumex tuberosus* L. [1, 17, 18, 19]**197. *P. passerinii* Schröter***Thesium bavarum* Schr. [8]**198. *P. pelargonii-zonalis* Doidge***Pelargonium* sp. (cult.)**199. *P. permixta* Sydow & H. Sydow***Cleistogenes serotina* (L.) Keng [2]**200. *P. persistens* Plowr.***Thalictrum minus* L. [8, 14]**201. *P. phlomidis* Thüm.***Phlomis herba-ventis* L. subsp. *pungens* (Willd.) Maire ex De Filipps [1],*Ph. tuberosa* L. [1]**202. *P. phragmitis* (Schumacher) Körn.***Phragmites australis* (Cav.) Trin. ex Steud. [18], *Rumex patientia* L. [18],*R. pulcher* L. [1]**203. *P. phymatospora* Lindr.***Seseli peucedanoides* (Bieb.) Kos.-Poljan. [5]**204. *P. physospermi* Pass.***Physospermum cornubiensis* (L.) DC. [8]**205. *P. pimpinellae* (Str.) Röhl.***Pimpinella anisum* L. (cult.), *P. major* (L.) Huds. [15], *P. peregrina* L. [1],*P. saxifraga* L. [8, 11], *P. tragiun* Vill. subsp. *polyclada* (Boiss. & Heldr.)Tutin [12], *P. tragiun* Vill. subsp. *lithophila* (Schischk.) Tutin [5]**206. *P. poarum* Nielsen***Petasites albus* (L.) Gaertn. [5, 15], *P. hybridus* (L.) Gaertn. [8, 11, 12, 15,17, 20], *P. kablikianus* Tausch ex Berch. [17], *Poa annua* L. [5, 15], *P.**cenisia* All. [15], *P. compressa* L. [5, 17], *P. media* Schur. [5], *P. nemoralis*L. [14, 15], *P. palustris* L. [15], *P. pratensis* L. [4, 10, 16, 17, 18, 19], *P.**trivialis* L. [2, 14, 20], *Tussilago farfara* L. [2, 8, 15, 17]**207. *P. podospermi* DC.***Scorzonera laciniata* L. [5, 6, 7, 16]**208. *P. polygoni* Alb. & Schwein.***Bilderdykia convolvulus* (L.) Dum. [5, 6, 10], *B. dumetorum* (L.) Dum.[14, 15], *Geranium columbinum* L. [20], *G. pusillum* L. [2]**209. *P. polygoni-alpini* Cruchet & Mayor***Pleuropterypyrum undulatum* (A. Murr.) A. & D. Loeve [14, 15]**210. *P. polygoni-amphibii* Pers.**

Geranium molle L. [19], *G. pusillum* L. [19], *G. rotundifolium* L. [10], *Persicaria amphibia* (L.) S. Gray [2, 18], *P. maculata* (Raf.) S. Gray [18]

211. *P. procera* Dietel & Holway in Dietel

Hordelymus europaeus (L.) Harz. [7], *Leymus racemosus* (Lam.) Tzvel. subsp. *sabulosus* (Bieb.) Tzvel. [1]

212. *P. prostii* Moug. in Duby

Tulipa australis Link [5, 10], *T. thracica* Dav. [1]

213. *P. pseudocesatii* Cummins

Chrysopogon gryllus (L.) Trin. [12]

214. *P. pulsatillae* Kalchbr.

Pulsatilla montana (Hoppe) Rchb. [19]

215. *P. pulverulenta* Grev.

Epilobium alsinifolium Vill. [15, 17], *E. anagalidifolium* Lam. [14], *E. collinum* C. C. Gmel. [17], *E. hirsutum* L. [5, 8, 15, 18], *E. montanum* L. [14, 15], *E. obscurum* Schreb. [4, 5], *E. tetragonum* L. subsp. *lamyi* (Schultz) Nym. [3, 12]

216. *P. punctata* Link

Asperula purpurea (L.) Ehrend. [8], *Cruciata glabra* (L.) Ehrend. [5], *C. laevipes* Opiz [5, 8, 12, 14, 15, 16], *Galium album* Mill. [4, 6, 11, 15], *G. anisophyllum* Vill. [11, 15], *G. aparine* L. [14] *G. odoratum* (L.) Scop. [8], *G. rotundifolium* L. [15], *G. schultesii* Vest. [8, 15], *G. verum* L. [6, 14, 16]

217. *P. punctiformis* (Str.) Röhl.

Cirsium arvense (L.) Scop. [2, 3, 5, 6, 16, 17, 18], *C. (?) creticum* (Lam.) D'Urv. [18]

218. *P. purpurea* Cooke

Sorghum halepense (L.) Pers. [18]

219. *P. pygmaea* Jakob Eriksson

Calamagrostis arundinacea (L.) Roth [15], *C. epigeios* (L.) Roth [4]

220. *P. recondita* Roberge ex Desm.

Actaea spicata L. [15], *Aegilops cylindrica* Host [3, 8], *Ae. geniculata* Roth [1, 10, 17, 18], *Ae. triuncialis* L. [1, 17], *Agropyron pectiniforme* Roem. & Schult. [1], *Agrostis capillaris* L. [5, 14, 15, 17], *A. stolonifera* L. [5], *Alkanna tinctoria* (L.) Tausch [10], *Anchusa barbelieri* (All.) Vitm. [1, 5], *A. leptophylla* Roem. & Schult. [1], *A. officinalis* L. (cult.), *A. velenovskyi* (Gusul.) Stoj. [1], *Arrhenatherum elatius* (L.) J. & K. Pressl [1], *Bromus arvensis* L. [6, 15], *B. commutatus* Schrad. [6, 8], *B. erectus* Huds. [1], *B. japonicus* Thunb. [1, 18], *B. mollis* L. [6, 15], *B. racemosus* L. [5, 16], *B. scoparius* L. [10, 17, 18], *B. secalinus* L. [6], *B. squarrosus* L. [1, 5, 8], *B.*

sterilis L. [18], *B. tectorum* L. [6, 15, 16], *Buglossoides arvensis* (L.) Johnst. [6], *B. purpureo-caerulea* (L.) Johnst [4], *Cerinthe minor* L. [7, 14], *Clematis integrifolia* L. [3], *C. recta* L. [8, 19], *C. vitalba* L. [1, 5, 7, 8, 15, 17, 18, ?-20], *C. viticella* L. [15], *Delphinium balcanicum* Pawl. [10], *Echium italicum* L. [10, 12, 14], *E. plantagineum* L. [1], *E. vulgare* L. [14], *Elymus caninus* (L.) L. [1, 19], *E. elongatus* (Host) W. Greut. [1, 2, 19], *E. farctus* (Vis.) Runem. ex Meld. [1, 18], *E. hispidus* (Opiz) Meld. [8, 18, 19], *E. repens* (L.) Gould. [2, 3, 4, 5], ? *Festucopsis sancta* Janka [14], *Helleborus cyclophyllus* Boiss. [5], *Hordelymus europaeus* (L.) Harz [8], *Hordeum hystrix* Roth [17], *Milium effusum* L. [15], *Myosotis arvensis* (L.) Hill. [5], *M. incrassata* Guss. [19], *M. ramosissima* Roch. [18], *Pulmonaria angustifolia* L. [16], *P. officinalis* L. [5, 8], *Secale cereale* L. (cult.), *Symphytum bulbosum* Schim. [15], *S. tuberosum* L. [8, 15], *Thalictrum* sp. [14], *Triticum aestivum* L. (cult.), *T. durum* Desf. (cult.)

221. *P. ribis* DC.

Ribes petraeum Wulf. [15]

222. *P. romagnoliana* Maire & Sacc.

Pycreus longus (L.) Hay. [18]

223. *P. rugulosa* Tranzschel

Peucedanum arenarium W. & K. [14, 16, 17], *P. carvifolium* Vill. [14]

224. *P. salviae* Unger

Salvia glutinosa L. [4, 15, 17]

225. *P. saniculae* Grev.

Sanicula europaea L. [15]

226. *P. saxifragae* Schlecht.

Saxifraga graeca Boiss. [14], *S. rotundifolia* L. [14, 15], *S. stellaris* L. [14, 15]

227. *P. scillae-rubrae* Cruchet

Festuca sp. [14], *Scilla bifolia* L. [8, 15]

228. *P. scirpi* DC.

Bolboschoenus maritimus (L.) Palla [15], *Holoschoenus vulgaris* Link [8], *Nymphoides peltata* (S. G. Gmel.) O. Kuntze [2, 3], *Schoenoplectus lacustris* (L.) Palla [1, 2], *Scirpus sylvaticus* L. [17]

229. *P. selini-carvifoliae* Šävul.

Selinum carvifolia L. [2, 5, 7]

230. *P. senecionis-acutiformis* Hasler, Mayor & Cruchet

Senecio doronicum (L.) L. subsp. *glaberrimus* (Roch.) Kožuharov & N. Andr. [14]

231. *P. sesleriae* Reichardt

Sesleria comosa Vel. [15]

232. *P. sessilis* W. G. Schneider in Schröter

Arum italicum Mill. [13], *Festuca picturata* Pils [15], *Leucojum aestivum* L. [19], *Muscari comosum* (L.) Mill. [15], *Polygonatum latifolium* (Jacq.) Desf. [19]

233. *P. sii-falcariae* Schröter

Falcaria vulgaris Bernh. [19]

234. *P. sileris* W. Voss

Laser trilobum (L.) Borkh. [1, 8]

235. *P. singularis* Magnus

Anemone ranunculoides L. [2, 8]

236. *P. smyrnii* Biv.-Bern.

Smyrnium perfoliatum L. [5, 8]

237. *P. soldanellae* Focke

Soldanella chrysostricta Kress [15], *S. pusilla* Baumg. [14, 15], *S. rhodopaea* F. K. Mey. [8, 15]

238. *P. sorghi* Schwein.

Zea mays L. (cult.)

239. *P. stachydis* DC.

Stachys angustifolia Bieb. [10], *S. recta* L. [14, 17]

240. *P. stipae* Arthur

Satureja montana L. [16], *Stipa capillata* L. [2], *Stipa* sp. [17], *Thymus pannonicus* All. [1], *T. pulegioides* L. [5]

241. *P. stojanovii* Hinkova

Primula farinosa L. [14, 15]

242. *P. striiformis* Westend.

Aegilops cylindrica Host [3, 18], *Ae. geniculata* Roth [1, 10], *Ae. neglecta* Req. ex Bertol. [1, 17, 18], *Ae. triuncialis* L. [14, 18, 19], *Agropyron cristatum* (L.) Gaertn. [7], *Avena barbata* Pott ex Link [10], *A. fatua* L. [20], *Calamagrostis epigeios* (L.) Roth [7], *Dactylis glomerata* L. [8], *Dasypyrum villosum* (L.) Cand. [17], *Elymus elongatus* (Host) Greut. [14], *E. repens* (L.) Gould. [2, 7], *Hordelymus europaeus* (L.) Harz [15], *Hordeum distichon* L. (cult.), *H. hystrix* Roth [10], *H. murinum* L., *H. vulgare* L. (cult.), *Leymus racemosus* (Lam.) Tzvel. subsp. *sabulosus* (Bieb.) Tzvel. [1], *Lolium perenne* L. [16], *L. rigidum* Gaud. [1], *L. temulentum* L. [7, 17], *Secale cereale* L. (cult.), *S. montanum* Guss. [15], *S. sylvestre* Host [1], *Stipa aristella* L. [2], *Taeniatherum caput-medusae* (L.) Nevski [1, 17], *Triticum aestivum* L. (cult.)

243. *P. svendsenii* Lindr.

Anthriscus sylvestris (L.) Hoffm. [8]

243a. *P. syriaca* Sydow & H. Sydow

Crucianella graeca Boiss. [18]

244. *P. tageticola* Dietel & Holway in Holway

Tagetes sp. (cult.)

245. *P. tanacetii* DC.

Tanacetum corymbosum (L.) Schultz-Bip. [8, 15], *T. parthenium* (L.) Schultz-Bip. [17], *T. vulgare* L. [15]

246. *P. thesii* Chaillet in Duby

Thesium alpinum L. [8, 15], *T. arvense* Horvatov. [15], *T. bavarum* Schr. [17], *T. divaricatum* Jan. ex Mert. & Koch. [17], *T. dollineri* Murb. [19], *T. linophyllum* L. [17]

247. *P. thlaspeos* Schubad

Thlaspi kovatsii Heuff. [15]

248. *P. thymi* (Fueckel) P. Karsten

Thymus sp. [14]

249. *P. tulipae* Schröter

Tulipa rhodopea Vel. [17]

250. *P. tuyutensis* Speg.

Cressa cretica L. [1]

251. *P. tyrimni* Gonz. Frag.

Tyrimnus leucographus (L.) Cass. [10]

252. *P. uliginosa* Juel

Parnassia palustris L. [8]

253. *P. uralensis* Tranzschel

Senecio nemorensis L. subsp. *fuchsii* (C. Gmel.) Cel. [8], *S. nemorensis* L. subsp. *nemorensis* [15]

254. *P. variabilis* Grev.

Taraxacum erythrospermum Andr. ex Bess. [20], *T. officinale* Web. [4, 14, 15]

255. *P. veratri* Duby

Veratrum lobelianum Bernh. [8, 15, 17]

256. *P. veronicae* Schröter

Veronica montana L. [17], *V. orchidea* Crantz [14]

257. *P. veronicarum* DC.

Veronica urticifolia Jacq. [14, 15]

258. *P. vincae* Berk.

Vinca herbacea W. & K. [1, 2], *V. major* L. [2]

259. *P. violae* DC.

Viola alba Bess. [11, 15], *V. canina* L. [2, 5, 8, 14, 15], *V. dacica* Borb. [5, 17], *V. hirta* L. [8, 15], *V. jordanii* Hanry (cult.), *V. kitaibeliana* Schult. [2], *V. odorata* L. [2, 11, 15, 17], *V. reichenbachiana* Jord. ex Boreau [5, 8, 11, 15, 16, 17], *V. riviniana* Rchb. [16], *V. tricolor* L. [3]

260. *P. virgae-aureae* (DC.) Lib.

Solidago virgaurea L. [15, 17]

261. *P. xanthii* Schwein.

Xanthium italicum Moret. [2, 3, 10, 18], *X. strumarium* L. [19]

PUCCINIASTRUM OTTH

262. *P. agrimoniae* (Dietel) Tranzschel

Agrimonia eupatoria L. [4], *Agrimonia* sp. [8, 17]

263. *P. areolatum* (Fr.) Otth

Picea abies (L.) Karst. [15]

264. *P. epilobii* Otth

Epilobium angustifolium L. [15], *E. hirsutum* L. [5], *E. montanum* L. [17], *E. roseum* Schreb. [15]

265. *P. goeppertianum* (Kühn) Kleb.

Abies alba Mill. [15, 17], *Vaccinium vitis-idaea* L. [15, 17]

266. *P. guttatum* (Schröter) Hyl., Jørstad & Nannf.

Galium album Mill. [14], *G. aparine* L. [17], *G. odoratum* (L.) Scop. [14], *G. rotundifolium* L. [5], *G. verum* L. [4]

267. *P. pyrolae* Dietel ex Arthur

Moneses uniflora (L.) A. Gray [15], *Orthilia secunda* (L.) House [14], *Pyrola chlorantha* Swartz [15, 17], *P. media* Swartz [15]

268. *P. vaccinii* (Wint.) Jørstad

Vaccinium myrtillus L. [15], *V. uliginosum* L. [8], *V. vitis-idaea* L. [15]

SORATAEA H. SYDOW

269. *S. cerasi* (Castagne) Cummins & Y. Hirats.

Cerasus avium (L.) Moench (cult.), *Eranthis bulgaricus* (Stef.) Stef. [4]

TRACHYSPORA FUCKEL

270. *T. intrusa* (Grev.) Arthur

Alchemilla bulgarica Rothm. [8], *A. catachnoa* Rothm. [15], *A. flabellata* Buser [15], *A. glaucescens* Wallr. [15], *A. gracillima* Rothm. [15], *A. heterophylla* Rothm. [15], *Alchemilla* spp. [5, 7, 8, 14]

TRANZSCHELIA ARTHUR**271. *T. anemones* (Pers. : Pers.) Nannf. in Lundell & Nannf.**

Anemone nemorosa L., *Pulsatilla montana* (Hoppe) Rchb. [7, 15], *Thalictrum minus* L. [12, 14]

272. *T. discolor* (Fueckel) Tranzschel & Litv.

Amygdalus communis L. (cult.), *Anemone apennina* L. subsp. *blanda* (Schott & Kotschy) Hay. [1, 4, 5, 10, 19], *A. coronaria* L. (cult.), *A. pavonina* Lam. [1, 5, 10, 11], *Armeniaca vulgaris* Lam. (cult.), *Cerasus avium* (L.) Moench (cult.), *C. mahaleb* (L.) Mill. (cult.), *C. vulgaris* Mill. (cult.), *Persica vulgaris* Mill. (cult.), *Prunus cerasifera* Ehrh. (cult. and spont.), *P. domestica* L. (cult.), *P. domestica* L. subsp. *insititia* (L.) Schneider [1], *P. spinosa* L. [4, 5]

273. *T. pruni-spinosae* (Pers. : Pers.) Dietel

Amygdalus communis L. (cult.), *Anemone nemorosa* L. [15], *A. ranunculoides* L. [8, 15], *Armeniaca vulgaris* Lam. (cult.), *Cerasus mahaleb* (L.) Mill. (cult.), *C. vulgaris* Mill. (cult.), *Prunus cerasifera* Ehrh. (cult. and spont.), *P. domestica* L. (cult.), *P. domestica* L. subsp. *insititia* (L.) Schneider [2], *P. spinosa* L. [4, 8]

TRIPHAGMIOPSIS NAUMOV**274. *T. isopyri* (Moug. & Nestler) Tranzschel**

Isopyrum thalictroides L. [8,16]

TRIPHAGMIUM LINK**275. *T. filipendulae* (Lasch) Pass.**

Filipendula vulgaris Moench [15,19]

276. *T. ulmariae* (DC.) Link

Filipendula ulmaria (L.) Maxim. [8,15]

UREDINA (NIGREDO : PERS.) PERS.

277. *U. tropaeoli* Desm.

Tropaeolum majus L. (cult.)

UROMYCES (LINK) UNGER

278. *U. acetosae* Schröter

Rumex acetosa L. [15], *R. arifolius* All. [8]

279. *U. acuminatus* Arthur

Phlox sp. (cult.)

280. *U. airae-flexuosae* Ferd. & Winge

Lerchenfeldia flexuosa (L.) Schur. [[11]

281. *U. alpestris* Tranzschel

Euphorbia cyparissias L. [14, 16]

282. *U. alpinus* Schröter

Rumex alpinus L. [15]

283. *U. ambiguus* (DC.) Fuckel

Allium ampeloprasum L. [19], *A. angulosum* L. [3], *A. atrovioleaceum* Boiss. [17], *A. rotundum* L. [11, 16], *A. schoenoprasum* L. [15], *A. scorodoprasum* L. [1, 18], *A. vineale* L. [11]

284. *U. anthyllidis* Schröter

Anthyllis vulneraria L. [2, 6, 12], *Cicer arietinum* L. (cult.), *Colutea arborescens* L. [1, 10], *Coronilla scorpioides* (L.) Koch [18], *C. varia* L. [4], *Dorycnium graecum* (L.) Ser. in DC. [20], *Hippocrepis ciliata* Willd. [17, 18], *Lotus aegyptius* (Griseb.) Boiss. [10], *Lupinus albus* L. [17], *L. angustifolius* L. [2], *L. polyphyllus* Lindley (cult.), *Medicago minima* (L.) Bart. [10, 18], *M. rigidula* (L.) All. [10, 11], *Trifolium echinatum* Bieb. [19], *Vicia lathyroides* L. [18]

285. *U. apiosporus* Hazsl.

Primula minima L. [14, 15]

286. *U. appendiculatus* (Pers. : Pers.) Unger

Phaseolus coccineus L. (cult.), *Ph. vulgaris* L. (cult.)

287. *U. arenariae-leptoclados* Vienn.-Bourg.

Arenaria leptoclados (Rchb.) Guss. [5, 19]

288. *U. armeriae* Kickx

Armeria alpina Willd. [14, 15], *A. rumelica* Boiss. [8, 15, 16]

289. *U. baeumlerianus* Bubák

Melilotus alba Med. [1], *M. officinalis* (L.) Pall. [16]

290. *U. behenis* (DC.) Unger

Silene armeria L. [8], *S. graeca* Boiss. & Sprun. [10], *S. roemerii* Friv. [16], *S. vulgaris* (Moench) Garcke [15]

291. *U. beticola* (Bellynck) Boerema, Loerakker, Hamers

Beta vulgaris L. (cult.)

292. *U. chenopodii* (Duby) Schröter

Suaeda maritima (L.) Dum. [1]

293. *U. cristulatus* Tranzschel

Euphorbia barrelieri Savi subsp. *thessala* (Form.) Bornm. [7], *E. salicifolia* Host [2], *E. seguerana* Neck. [7]

294. *U. croci* Pass. in Rabenh.

Crocus biflorus Mill. [16], *C. veluchensis* Herb. [15]

295. *U. dactylidis* Otth

Agrostis capillaris L. [17], *A. verticillata* Vill. [11], *Alopecurus myosuroides* Huds. [18], *Bellardiochloa violacea* (Bell.) Chiov. [8], *Dactylis glomerata* L. [2], *Festuca heterophylla* Lam. [15], *F. rubra* L. [5, 8], *Festuca* spp. [5, 15, 17], *Molinia coerulea* (L.) Moench [18], *Poa bulbosa* L. [8], *P. compressa* L. [4, 17], *P. nemoralis* L. [18], *P. pratensis* L. [3], *P. sylvicola* Guss. [15], *P. trivialis* L. [18], *Ranunculus acris* L. [11], *R. arvensis* L. [6], *R. ficaria* L. [8, 11], *R. flammula* L. subsp. *reptans* (L.) Syme [18], *R. repens* L. [20], *R. rumelicus* Grsb. [8], *R. serbicus* Vis. [15]

296. *U. dianthi* (Pers. : Pers.) Niessl

Arenaria leptoclados (Rchb.) Guss. [20], *Cerastium brachypetalum* Pers. [14], *Dianthus armeria* L. [1, 2], *D. barbatus* L. [18], *D. caryophyllus* L. (cult.), *D. petraeus* W. & K. [5], *D. pinifolius* S. & S. [10, 17], *D. roseoluteus* Vel. [10], *D. viscidus* Bory & Chaub. [6], *Euphorbia seguerana* Neck. [3], *Petrorrhagia prolifera* (L.) Ball & Heyw. [17], *P. velutina* (Guss.) Ball & Heyw. [20], *Saponaria officinalis* L. [6], *Vaccaria hispanica* (Mill.) Rasch. [2], *Velezia rigida* L. [10, 19, 20]

297. *U. doricus* Maire

Silene caliacrae D. Jord. & P. Pan. [1], *S. gigantea* L. [2]

298. *U. ervi* Westend.

Vicia hirsuta (L.) S. F. Gray [15], *V. sativa* L. [2], *V. tenuifolia* Roth [17]

299. *U. erythronii* (DC.) Pass.

Erythronium dens-canis L. [6, 8, 15]

300. *U. euphorbiae-corniculati* Jordi

Lotus angustissimus L. [18, 19, 20], *L. corniculatus* L. [6]

301. *U. fallens* (Arthur) Kern ex Barth.

Trifolium sp.

302. *U. ferulae* Juel

Ferulago campestris (Bess.) Grec. [4, 8, 15], *F. sylvatica* (Bess.) Rchb. [2, 8, 16]

303. *U. ficariae* (Schumacher) Fockel

Ranunculus ficaria L. [11, 15]

304. *U. fischeri-eduardi* Magnus

Vicia cracca L. [15], *V. incana* Gouan [6], *V. pannonica* Crantz subsp. *pannonica* [6], *V. pannonica* Crantz subsp. *striata* (Bieb.) Nym. [16, 19], *V. sativa* L., *V. tenuifolia* Roth [14], *V. varia* Host [6], *V. villosa* Roth [16]

305. *U. fulgens* Bubák

Chamaecytisus absinthioides (Janka) Kuzm. [14], *Ch. hirsutus* (L.) Link [15, 17], *Ch. supinus* (L.) Link [15]

306. *U. gageae* Beck

Gagea lutea (L.) Ker-Gaw.[8], *G. pratensis* (Pers.) Dumort. [1, 6]

307. *U. galegae* (Opiz) Sacc.

Galega officinalis L. [3, 10]

308. *U. geranii* (DC.) Fr.

Erodium ciconium (L.) L.Her. in Ait. [2], *Geranium columbinum* L. [3], *G. dissectum* L. [4], *G. macrorrhizum* L. [6], *G. pusillum* L. [18], *G. pyrenaicum* Burm f. [8, 14, 15], *G. rotundifolium* L. [17], *G. sylvaticum* L. [5]

309. *U. glycyrrhizae* (Rabenh.) Magnus

Glycyrrhiza glabra L. [3]

310. *U. graminis* (Niessl) Dietel

Caucalis platycarpos L. [2], *Melica ciliata* L. [2, 4]

311. *U. gypsophilae* Cooke

Vaccaria hispanica (Mill.) Rasch. [19]

312. *U. heimerlianus* Magnus

Vicia ervilia (L.) Willd. (cult.), *V. lutea* L. [4], *V. pannonica* Crantz subsp. *pannonica* [4], *V. pannonica* Crantz subsp. *striata* (Bieb.) Nym. [3]

313. *U. heliotropii* Sred.

Heliotropium europaeum L. [2, 10]

314. *U. inaequaltus* Lasch

Silene fabarioides Hausskn. [16], *S. heuffelii* Soo [5], *S. italica* (L.) Pers. [12], *S. otites* (L.) Wibel [15], *S. roemerii* Friv. [16], *S. viridiflora* L. [8, 15], *S. vulgaris* (Moench) Garcke [8]

315. *U. japonicus* Berk. & M. A. Curtis

Allium victorialis L. [15]

316. *U. jordanus* Bubák

Astragalus dasyanthus Pall. [18]

317. *U. junci* (Desm.) Tul.

Juncus sp. aff. *effusus* L. [1], *J. littoralis* C. A. Mey. [1], *J. tenuis* Willd. [8]

318. *U. klebahnii* E. Fischer

Astragalus glycyphyllos L. [9], *A. hamosus* L. [1, 2, 6, 7, 18], *A. onobrychis* L. [1, 7]

319. *U. laburni* (DC.) Otth

Chamaecytisus hirsutus (L.) Link [15], *Ch. supinus* (L.) Link [15], *Chamaespartium sagittale* (L.) Gibbs [8, 15], *Colutea arborescens* L. [15], *Corothamnus procumbens* (W. & K.) C. Presl [12], *Galega officinalis* L. [11, 18], *Genista carinalis* Grsb. [16], *G. depressa* Bieb. [8, 15], *G. ovata* W. & K. [8], *G. sessilifolia* DC. subsp. *trifoliata* (Janka) Kuzm. [7], *Laburnum anagyroides* Medic (cult.), *Lembotropis nigricans* (L.) Grsb. [5]

320. *U. laevis* Körn.

Euphorbia niciciana Borb. [1]

321. *U. lathyri-latifolii* Guyot

Lathyrus latifolius L. [3]

322. *U. leontices* (Bubák) Nattrass

Leontice leontopetalum L. [18]

333. *U. lilii* Fuckel

Fritillaria pontica Wahl. [20], *F. skorpilii* Vel. [18]

334. *U. limonii* (DC.) Berk.

Limonium gmelinii (Willd.) O. Kuntze [1], *L. latifolium* (Sm.) O. Kuntze [1], *Limonium* spp. [3, 19]

335. *U. lineolatus* (Desm.) Schröter in Rabenh.

Berula erecta (Huds.) Coville [18], *Bolboschoenus maritimus* (L.) Palla [18], *Oenanthe pimpinelloides* L. [20]

336. *U. lupinicolus* Bubák

Lupinus sp. (cult.)

337. *U. lycoctoni* (Kalchbr.) A. Trotter

Aconitum lycoctonum L. [14]

338. *U. mangeloti* Mayor & Vienn.-Bourg.

Vicia cassubica L. [20]

339. *U. minor* Schröter

Trifolium campestre Schreb. [15], *T. dalmaticum* Vis. [4], *T. montanum* L. [8], *T. subterraneum* L. [19]

340. *U. muscari* (Duby) Graves

Hyacinthella leucophaea (Koch) Schur [5, 7], *Hyacinthus orientalis* L. (cult.), *Muscari botryoides* (L.) Mill. [15, 16], *M. comosum* (L.) Mill. [4, 15], *M. racemosum* (L.) Lam. & DC. [1, 5, 11, 17, 18, 20], *M. tenuiflorum* Tausch [7], *Scilla bithynica* Boiss. [1]

341. *U. nerviphilus* (Grognot) Hotson

Trifolium fragiferum L. [18], *T. montanum* L. [14], *T. repens* L. [5, 8, 12, 16]

342. *U. onobrychidis* Bubák

Onobrychis alba (W. & K.) Desv. [17], *O. arenaria* (Kit.) DC. [8], *O. gracilis* Bess. [18], *O. lasiostachya* Boiss. [4], *O. montana* DC. subsp. *scardica* (Grsb.) Hal. [14], *O. viciifolia* Scop. (cult.)

343. *U. ononidis* Pass. in Rabenh.

Ononis arvensis L. [4, 8], *O. spinosa* L. [7, 16]

344. *U. pallidus* Niessl

Chamaecytisus supinus (L.) Link [5]

345. *U. pisi* (DC.) Otth

Euphorbia cyparissias L. [6], *Lathyrus aphaca* L. [3, 4, 19], *L. cicera* L. [3, 4], *L. laxiflorus* (Desf.) O. Kuntze [8], *L. nissolia* L. [3, 6, 16], *L. pratensis* L. [8, 15, 16], *L. setifolius* L. [18], *L. sylvestris* L. [18], *L. vernus* (L.) Bernh. [8], *Pisum elatius* Bieb. [1], *P. sativum* L. (cult.)

346. *U. polycnemi* (Libosch.) Tranzschel

Kochia laniflora (S. G. Gmel.) Borb. [1], *Petrosimonia brachiata* (Pall.) Bunge [1], *Salsola ruthenica* Iljin [1]

347. *U. polygoni-aviculariae* (Pers. : Pers.) P. Karsten

Bilderdykia dumetorum (L.) Dum. [2], *Polygonum alpestre* C. A. M. [18], *P. aviculare* L. [4, 5, 6, 15], *P. pulchellum* Loisel. [14]

348. *U. prangi* Har.

Hippomarathrum cristatus (DC.) Boiss. [18]

349. *U. primulae-integrifoliae* (DC.) Niessl

Primula deorum Vel. [15]

350. *U. proeminens* (DC.) Lev.

Euphorbia chamaesyce L. [2, 3, 6]

351. *U. punctatus* Schröter

Astragalus alopecurus Pall. [17], *A. dasyanthus* Pall. [3], *A. glaucus* Bieb. [1], *A. glycyphyllos* L. [15], *A. hamosus* L. [6], *A. monspessulanus* L. [17], *A. ponticus* Pall. [1], *A. pubiflorus* DC. [19], *A. spruneri* Boiss. [17], *A. thracicus* Grsb. [5], *A. varius* S. G. Gmel. [1]

352. *U. riloensis* Hinkova*Doronicum columnae* Ten. [15]**353. *U. rumicis* (Schumacher) Winter***Rumex acetosa* L. [6], *R. alpinus* L. [15, 17], *R. conglomeratus* Murr. [18], *R. crispus* L. [11], *R. obtusifolius* L. [15], *R. palustris* Sm. [2], *R. patientia* L. [17, 19], *R. pulcher* L. [1, 6, 19, 20], *R. sanguineus* L. [8, 20], *R. stenophyllus* Ledeb. [3]**354. *U. scrophulariae* Fuckel***Scrophularia aestivalis* Grsb. [15], *S. nodosa* L. [15, 17]**355. *U. scutellatus* (Pers. : Pers.) Lév.***Euphorbia agraria* Bieb. [1], *E. amygdaloides* L. [2], *E. barrelieri* Savi subsp. *thessala* (Form.) Bornm. [7], *E. cyparissias* L. [7, 14, 15], *E. nicaeensis* All. [2], *E. salicifolia* Host [2], *E. seguerana* Neck. [6]**356. *U. silenes-ponticae* Const.***Silene thymifolia* Sibth. & Sm. [1]**357. *U. sparsus* (Schm. & Kunze) Cooke***Spergularia* (?) *media* (L.) C. Presl [1]**358. *U. striatus* Schröter***Euphorbia* sp., *Medicago arabica* (L.) Huds. [3], *M. falcata* L. [4, 5], *M. lupulina* L. [6, 9], *M. marina* L. [1], *M. minima* (L.) Bart. [14], *M. orbicularis* (L.) Bart. [4, 18], *M. polymorpha* L. [4], *M. prostrata* Jacq. (cult.), *M. rigidula* (L.) All. [5, 18], *M. sativa* L. (cult.), *Trifolium affine* C. Presl [18], *T. arvense* L. [1, 3, 4, 5, 6, 10, 15, 16, 17], *T. aureum* Poll. [4, 5, 14, 16, 17], *T. campestre* Schreb. [8, 16, 17, 18], *T. cherleri* L. [9, 13], *T. diffusum* Ehrh. [14], *T. dubium* Sibth. [4], *T. hirtum* All. [5, 7, 15], *T. incarnatum* L. [6], *T. micranthum* Viv. [6], *T. retusum* L. [5], *T. scabrum* L. [4], *T. striatum* L. [19], *T. tenuifolium* Ten. [10], *T. trichopterum* Panč. [15]**359. *U. striolatus* Tranzschel***Euphorbia cyparissias* L. [5]**360. *U. sublaevis* Tranzschel***Euphorbia nicaeensis* All. [1, 18]**361. *U. trifolii-purpurei* Const.***Trifolium purpureum* Loisel. [1, 10]**362. *U. trifolii-repentis* Liro***Trifolium campestre* Schreb., *T. dalmaticum* Vis. [19], *T. echinatum* Bieb. [4], *T. fragiferum* L. [11], *T. hirtum* All. [10], *T. hybridum* L. subsp. *elegans* (Savi) A. & G. (cult.), *T. hybridum* L. subsp. *hybridum* [8, 17], *T. incarnatum* L. subsp. *molinerii* (Balb. ex Hornem.) Syme [15, 16], *T. medium* L. [6, 16], *T. michelianum* Savi [8], *T. nigrescens* Viv. [17, 18], *T.*

pallescens Schreb. (cult.), *T. patens* Schreb. [15, 19], *T. pratense* L. [6, 11, 18], *T. repens* L. [5, 15, 18], *T. resupinatum* L. [4, 19], *T. setiferum* Boiss. [17], *T. trichopterum* Panč. [9, 17]

363. *U. trigonellae* Pass.

Trigonella monspeliaca L. [19], *T. striata* L. f. [6, 7]

364. *U. valerianae* (DC.) Fockel

Valeriana montana L. [15], *V. officinalis* L. [15], *V. tripteris* L. [14, 15], *Valerianella* sp. [8]

365. *U. valesiacus* E. Fischer

Vicia ervilia (L.) Willd. (cult.)

366. *U. veratri* (DC.) Schröter

Adenostyles alliariae (Gouan) Kern. [15], *Veratrum lobelianum* Bernh. [8]

367. *U. verbasci* Niessl

Verbascum abietinum Borb. [15], *V. lichnitis* L. [10, 15], *V. thapsiforme* Schrad. [15], *Verbascum* spp. [2, 6, 8, 17]

368. *U. verruculosus* Schröter

Silene alba (Mill.) E. Krause (cult.)

369. *U. viciae-cracca* Const.

Vicia latifolia Roth [4]

370. *U. viciae-fabae* (Pers. : Pers.) Schröter

Lathyrus alpestris (W. & K.) Kit. & Celak. subsp. *friedrichstalii* (Grseb.) K. Maly [5, 8], *L. niger* (L.) Bernh. [5, 8], *L. pratensis* L. [8, 15], *L. sylvestris* L. [18], *L. tuberosus* L., *L. venetus* (Mill.) Wohlf. in Koch [8], *L. vernus* (L.) Bernh. [2, 5, 8, 11, 15, 17], *Lens culinaris* Medic. (cult.), *Vicia angustifolia* Grufb. [6, 18, 19], *V. bithynica* (L.) L. [1, 2], *V. cassubica* L. [19], *V. faba* L. (cult.), *V. grandiflora* Scop. [4, 18], *V. hirsuta* (L.) S. F. Gray [3, 4, 20], *V. incana* Gouan [17], *V. lathyroides* L. [1, 17, 19], *V. pannonica* Crantz [8], *V. sativa* L. (cult.), *V. sepium* L. [8, 15], *V. tenuifolia* Roth [2], *V. varia* Host [6, 18], *V. villosa* Roth [3, 10]

XENODOCHUS SCHLECHT.

371. *Xenodochus carbonarius* Schlecht.

Sanguisorba officinalis L. [8]

ZAGHOUANIA PAT.

372. *Zaghouania phillyreae* Pat.*Phyllirea latifolia* L. [10, 17]**INDEX TO SYNONYMS OF RUSTS**

The correct rust taxa are in bold. The following abbreviations are used throughout for rust generic names: *Ae.* = *Aecidium*, *Cae.* = *Caeoma*,

Ch. = *Chrysomyxa*, *C.* = *Coleosporium*, *Cr.* = *Cronartium*, *Cumm.* =

Cumminsia, *G.* = *Gymnosporangium*, *K.* = *Kuehneola*, *M.* =

Melampsora, *M-ella* = *Melampsorella*, *Mil.* = *Milesina*, *Miya.* = *Miyagia*,

N. = *Nyssopsora*, *O.* = *Ochropsora*, *Ph.* = *Phragmidium*, *P.* = *Puccinia*,

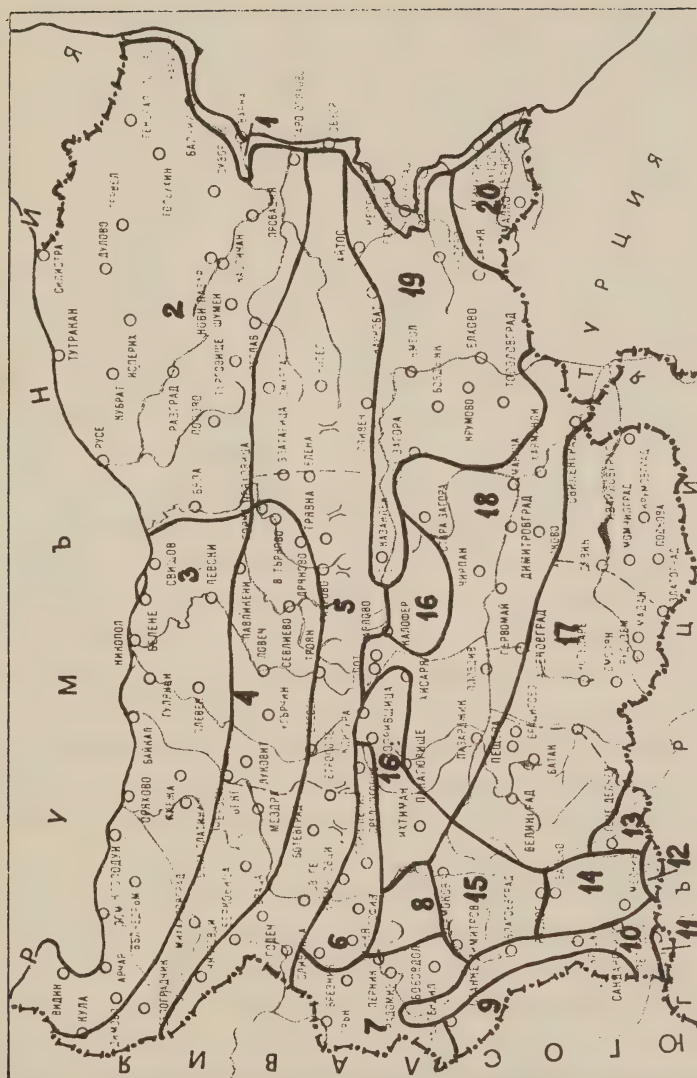
P-um = *Pucciniastrum*, *R.* = *Roestelia*, *Th.* = *Thekopsora*, *Tr.* =

Triphragmium, *Tranz.* = *Tranzschelia*, *Tr-opsis* = *Triphragmiopsis*, *Ur.* =

Uredo, *U.* = *Uromyces*

AECIDIUM anchusae Jakob Eriksson & Henn. = *P. recondita*, *Ae. asperifolii* Pers. = *P. recondita*, *Ae. berberidis* Pers. : Pers. = *P. graminis*, *Ae. cirsii* DC. = *P. dioicae*, *Ae. delphinii* Barth. = *P. recondita*, *Ae. elatinum* Alb. & Schwein. = *M-ella caryophyllacearum*, *Ae. lactucinum* Lagerh. & Lindroth = *P. opizii*, *Ae. leucospermum* DC. = *O. ariae*, *Ae. periclymeni* Schumacher = *P. festucae*, *Ae. pulmonariae* Thüm. = *P. recondita*, *Ae. punctatum* Pers. : Pers. = *Tranz. prunispinosae*, *Ae. rhamni* J. F. Gmelin : Pers. = *P. coronata*, *Ae.*

Fig. 1. Floristic regions of Bulgaria: 1 - Black sea coast; 2 - Northeast Bulgaria; 3 - Danubian Plain; 4 - Balkan foothill region; 5 - Balkan Mt.; 6 - Sofia region; 7 - Znepole region; 8 - Vitosha Mt.; 9 - West Borderline Mts.; 10 - River Strouma; 11 - Belasitza Mt.; 12 - Slavyanka Mt.; 13 - River Mesta; 14 - Pirin Mt.; 15 - Rila Mt.; 16 - Sredna Gora Mt.; 17 - Rhodopes Mts.; 18 - Thracian Lowland; 19 - Toundja Hilly Country; 20 - Strandja Mt.



rubellum Pers. in J. F. Gmelin = *P. phragmitis*, *Ae. scillae* Fuckel = *P. scillae-rubrae*, *Ae. strobilinum* (Alb. & Schwein.) Rees = *P.-um areolatum*, *Ae. symphyti* Thüm. = *P. recondita*, *Ae. taraxaci* Kunze & Schm. = *P. dioicae*, *Ae. tussilaginis* Pers. = *P. poarum*, *Ae. valerianellae* Biv.-Bern. = *P. gladioli*, *Ae. violae* Schumacher = *P. violae*

CAEOMA alliorum auct. = *Cae. allii-ursini*, *Cae. pinitorquum* de Bary = *M. populnea*, *CALYPTOSPORA goeppertiana* Kühn = *P.-um goeppertianum*, *CHRYSOMYXA pyrolae* (DC.) Rostrup = *Ch. pyrolata*, *Ch. rhododendri* de Bary = *Ch. ledi*, *COLEOSPORIUM cacaliae* Otth = *C. tussilaginis*, *C. campanulae* (Pers.) Lév. = *C. tussilaginis*, *C. campanulae-rapunculoides* Kleb. = *C. tussilaginis*, *C. campanulae trachelii* Kleb. = *C. tussilaginis*, *C. doronici* Namysl. ex Sydow & H. Sydow = *C. tussilaginis*, *C. euphrasiae* Winter in Rabenh. = *C. tussilaginis*, *C. inulae* Rabenh. = *C. tussilaginis*, *C. melampyri* (Rebent.) P. Karsten = *C. tussilaginis*, *C. petasitis* auct. = *C. tussilaginis*, *C. sonchi* auct. = *C. tussilaginis*, *C. sonchi-arvensis* Winter in Rabenh. = *C. tussilaginis*, *C. telekiae* Thüm. = *C. tussilaginis*, *CRONARTIUM asclepiadeum* (Willd.) Fr. = *Cr. flaccidum*, *Cr. gentianeum* Thüm. = *Cr. flaccidum*, *CUMMINSELLA sanguinea* Arthur = *Cumm. mirabilissima*

GYMNOSPORANGIUM aucupariae-juniperinum Kleb. = *G. cornutum*, *G. aurantiacum* Chev. = *G. cornutum*, *G. juniperinum* (L. : Pers.) C. Mart. = *G. cornutum*, *G. mali-tremelloides* Kleb. = *G. tremelloides*

MELAMPSORA abieti-capraearum Tubeuf = *M. epitea*, *M. agrimoniae* auct. = *P.-um agrimoniae*, *M. allii-salicis-albae* Kleb. = *M. salicis-albae*, *M. alpina* Juel = *M. epitea*, *M. euphorbiae* f. sp. amygdaloides W. Müller = *M. euphorbiae*, *M. euphorbiae-dulcis* Otth = *M. euphorbiae*, *M. euphorbiae-gerardianae* W.

Müller = *M. euphorbiae*, *M. evonymi-caprearum* Kleb. in Pringsh. = *M. epitea*, *M. farinosa* Schröter = *M. caprearum*, *M. galanthi-fragilis* Kleb. = *M. allii-fragilis*, *M. helioscopiae* Winter in Rabenh. = *M. euphorbiae*, *M. larici-caprearum* Kleb. = *M. caprearum*, *M. larici-epitea* Kleb. = *M. epitea*, *M. larici-tremulae* Kleb. = *M. populnea*, *M. lini-cathartici* Kupr. in Kupr. & Tranzschel = *M. lini*, *M. liniperda* (Körn.) Palm = *M. lini*, *M. lini-usitatissimi* Kupr. in Kupr. & Tranzschel = *M. lini*, *M. magnusiana* Wagner ex Kleb. = *M. populnea*, *M. pinitorqua* Rostrup = *M. populnea*, *M. populina* auct. = *M. populnea*, *M. pulcherrima* (Bubák) Maire in H. & P. Sydow = *M. populnea*, *M. reticulatae* A. G. Blytt = *M. epitea*, *M. ribesii-epitea* Kleb. = *M. epitea*, *M. ribesii-purpureae* Kleb. in Pringsh. = *M. epitea*, *M. rostrupii* Wagner ex Kleb. = *M. populnea*, *M. salicina* auct. = *M. epitea*, *MELAMPSORELLA cerastii* Winter = *M-ella caryophyllacearum*, *MILESINA polypodii* F. B. White & Faull = *Mil. dieteliana*

OCHROPSORA sorbi (Oudem.) Dietel = *O. ariae*

PHRAGMIDIUM albidum (Kühn) Lagerh. = *K. uredinis*, *Ph. disciflorum* (Tode) James = *Ph. mucronatum*, *Ph. fragariastrum* (DC.) Schröter = *Ph. fragariae*, *Ph. rosae-alpinae* Winter in Rabenh. = *Ph. fusiforme*, *Ph. rosarum* Fuckel = *Ph. rosae-pimpinellifoliae*, *Ph. rubi* (Pers. : Pers.) Winter in Rabenh. = *Ph. bulbosum*, *Ph. rubi-saxatilis* Liro = *Ph. acuminatum*, *Ph. subcorticium* Winter in Rabenh. = *Ph. mucronatum*, *PUCCINIA actaeae-agropyri* E. Fischer = *P. recondita*, *P. actaeae-elymi* Mayor = *P. recondita*, *P. aegilopsis* Maire = *P. recondita*, *P. aethusae* Mart. = *P. nitida*, *P. agropyri* Ell. & Ev. = *P. recondita*, *P. agropyrina* Jakob Eriksson = *P. recondita*, *P. agrostidis* Plowr. = *P. recondita*, *P. airae* Mayor & Cruchet = *P. brachypodii*, *P. alnetorum* Gäum. = *P. magnusiana*, *P. andersonii* Berk. & Broome = *P. cnici-*

oleracei, *P. anthoxanthi* Fuckel = *P. graminis*, *P. argentata* (Schultz) Winter = *P. impatientis*, *P. arrhenatheri* Jakob Eriksson = *P. brachypodii*, *P. arrhenathericola* E. Fischer = *P. recondita*, *P. artemisiella* Sydow & H. Sydow = *P. absinthii*, *P. bardanae* (Wallr.) Corda = *P. calcitrapae*, *P. barkhausiae-rhoeadifoliae* Bubák = *P. crepidis*, *P. baryi* Berk. & Broome + *P. baryi* Winter = *P. brachypodii*, *P. bromina* Jakob Eriksson = *P. recondita*, *P. bullata* (Pers.) Winter = *P. angelicae*, *P. bupleuri-falcati* (DC.) Winter = *P. bupleuri*, *P. cardui-pycnocephali* Sydow & H. Sydow = *P. calcitrapae*, *P. carduorum* Jacky = *P. calcitrapae*, *P. cari-bistortae* Kleb. = *P. bistortae*, *P. caricis* (Schumacher) Rebert. = *P. caricina*, *P. caricis-frigidae* E. Fischer = *P. dioicae*, *P. caricis-montanae* E. Fischer = *P. dioicae*, *P. carlinae* Jacky = *P. calcitrapae*, *P. caulincola* Schneider = *P. thymi*, *P. celakovskyana* Bubák = *P. punctata*, *P. centaureae* DC. = *P. calcitrapae*, *P. cerasi* Castagne = *S. cerasi*, *P. cerinthes-agropyryna* Tranzschel = *P. recondita*, *P. chondrillae* Corda = *P. maculosa*, *P. chondrillina* Bubák & Sydow = *P. hieracii*, *P. cichorii* ("DC.") Bellardi ex Kickx f. = *P. hieracii*, *P. cirsii* Lasch in Rabenh. = *P. calcitrapae*, *P. cirsii-eriophori* Jacky = *P. cnici*, *P. cirsii-lanceolati* Schröter = *P. cnici*, *P. clematidis-secalis* Dupias = *P. recondita*, *P. conferta* Dietel & Holway = *P. cnici-oleracei*, *P. coronifera* Kleb. = *P. coronata*, *P. croci-pallasii* Sävul. = *P. croci*, *P. dispersa* Jakob Eriksson & Henn. = *P. recondita*, *P. divergens* Bubák = *P. calcitrapae*, *P. dobrogensis* Sävul. & O. Sävul. = *P. caucasica*, *P. doricella* Sydow & H. Sydow = *P. hieracii*, *P. echinopsis* DC. = *P. calcitrapae*, *P. elymicola* Const. = *P. procera*, *P. epilobii-tetragoni* Winter in Rabenh. = *P. pulverulenta*, *P. expansa* Link in Willd. = *P. glomerata*, *P. falcariae* (Pers.) Fuckel = *P. sii-falcariae*, *P. festucina* H. Sydow & Sydow = *P. sessilis*, *P. fragosoi* Bubák = *P. hordei*, *P. fuckelii* Sydow & H. Sydow = *P. calcitrapae*, *P. fusca* (Pers. ex Gmel.) Winter in Rabenh. = *Tranz. anemones*, *P. galii*

auct. = *P. punctata*, *P. galii-silvatici* Otth = *P. punctata*, *P. galiorum* Link in Willd. = *P. punctata*, *P. glumarum* Jakob Eriksson & Henn. = *P. strüiformis*, *P. herniariae* Unger = *P. arenariae*, *P. holcicola* Guyot = *P. hordei*, *P. holcina* Jakob Eriksson = *P. hordei*, *P. hordei-maritimi* Guyot = *P. recondita*, *P. hordei-murini* Buchw. = *P. hordei*, *P. hyoseridis* (Schumacher) Liro = *P. hypochoeridis*, *P. jaceae* Otth = *P. hieracii*, *P. jaceae-leporinae* Tranzschel = *P. dioicae*, *P. leontodontis* Jacky = *P. hieracii*, *P. lollicola* Vienn.-Bourg. = *P. hordei*, *P. luzulae-maximae* Dietel = *P. obscura*, *P. madritensis* Maire = *P. recondita*, *P. magnusii* Kleb. = *P. caricina*, *P. maydis* Béreng. = *P. sorghi*, *P. millefolii* Fockel = *P. cnici-oleracei*, *P. milii* Jakob Eriksson = *P. brachypodii*, *P. mulgedii* Sydow & H. Sydow = *P. maculosa*, *P. oblongata* Winter in Rabenh. = *P. luzulae*, *P. obtegens* Tul. ex Fockel = *P. punctiformis*, *P. obtusata* (Otth) E. Fischer = *P. isiacae*, *P. paludosa* Plowr. = *P. caricina*, *P. paraphysata* Reichert = *P. hordei*, *P. petasiti-poarum* Gäum. & Eichh. = *P. poarum*, *P. petasiti-pulchellae* Lüdi = *P. poarum*, *P. peucedani-alsatici* Picb. = *P. angelicae*, *P. phalaridis* Plowr. = *P. sessilis*, *P. phleipratensis* Jakob Eriksson & Henn. = *P. graminis*, *P. picridis* Hazsl. = *P. hieracii*, *P. poae-nemoralis* Otth = *P. brachypodii*, *P. poae-sudeticae* Jørstad = *P. brachypodii*, *P. porri* Winter in Rabenh. = *P. allii*, *P. praecox* Bubák = *P. major*, *P. prenanthis* Lindroth = *P. maculosa*, *P. prenanthis-purpureae* Lindroth = *P. maculosa*, *P. pruni* DC. = *Tranz. pruni-spinosae*, *P. pruni-spinosae* Pers. : Pers. = *Tranz. pruni-spinosae*, *P. pyrethri* Rabenh. = *P. tanacetii*, *P. retifera* Lindroth = *P. chaerophylli*, *P. ribesii-caricis* Kleb. = *P. caricina*, *P. rubigo-vera* Winter in Rabenh. = *P. recondita*, *P. schirajewskii* Tranzschel in Tranzschel & Serebr. = *P. calcitrapae*, *P. schmidtiana* Dietel = *P. sessilis*, *P. semadenii* Gäum. = *P. angelicae*, *P. seseleos* Guyot = *P. nitida*, *P. silenes* Schröter in Winter = *P. behenis*, *P. silvatica* Schröter = *P. dioicae*, *P. simplex* (Körn.) Jakob

Eriksson & Henn. = *P. hordei*, *P. smyrnii* Corda = *P. smyrnii* Biv.-Bern., *P. sonchi* Roberge ex Desm. = *Miya. pseudosphaeria*, *P. stipae* Hora in Sydow = *P. stipae* Arthur, *P. stipina* Tranzschel ex Kleb. = *P. stipae*, *P. suaveolens* Rostrup = *P. punctiformis*, *P. symphyti-bromorum* F. Müller = *P. recondita*, *P. taraxaci* Plowr. = *P. hieracii*, *P. taraxaci-serotini* Picb. = *P. hieracii*, *P. thalictri-distichophylli* E. Fischer & Mayor = *P. recondita*, *P. tragopogi* auct. = *P. hystereum*, *P. trailii* Plowr. = *P. phragmitis*, *P. tremelloides* auct. = *G. tremelloides*, *P. triticina* Jakob Eriksson = *P. recondita*. *P. urticae-acutae* Kleb. = *P. caricina*, *P. urticae-caricis* Kleb. = *P. caricina*, *P. valantiae* Pers. = *P. galii-vernii*, *P. verruca* Thüm. = *P. cnici-oleracei*, *P. vulpiana* Guyot = *P. hordei*, *P. zopfii* Winter = *P. calthicola*, *PUCCINIASTRUM abieti-chamaenerii* Kleb. in Pringsh. = *P-um epilobii*, *P-um chamaenerii* Rostrup = *P-um epilobii*, *P-um pyrolae* Schröter = *P-um pyrolae* Dietel ex Arthur

ROESTELIA cancellata Rebent. = *G. sabinae*, *R. cornuta* Fr. = *G. cornutum*, *R. lacerata* Fr. = *G. clavariiforme*, *R. penicillata* Fr. = *G. tremelloides*

THECOPSORA areolata (Fr.) Magnus = *P-um areolatum*, *THEKOPSORA galii* de Toni in Sacc. = *P-um guttatum*, *Th. myrtilii* Tranzschel = *P-um vaccinii*, *Th. myrtilina* P. Karsten = *P-um vaccinii*, *Th. vacciniorum* (DC.) P. Karsten = *P-um vaccinii*, *Trachyspora alchemillae* Fuckel = *Trach. intrusa*, *TRANZSCHELIA pulsatillae* (Rostrup) Dietel = *Tranz. anemones*, *Tranz. punctata* Arthur = *Tranz. pruni-spinosae*, *Tranz. thalictri* (Chev.) Dietel = *Tranz. anemones*, *Tranz. suffusca* (Holway) Arthur = *Tranz. anemones*, *TRIPHragMIUM echinatum* Lév. = *N. echinata*, *Tr. isopyri* Moug. & Nestler = *Tr-opsis isopyri*, *Tr. ulmariae* Winter = *Tr. ulmariae* (DC.) Link

UREDOPoae-cenisiae Lüdi = *P. poarum*, *Ur. pyrolae* Winter in Rabenh. = *P-um pyrolae*, *UROMYCES aconiti* Fuckel = *U. lycoctoni*, *U. agrostidis* (Gonz. Frag.) Guyot = *U. dactylidis*, *U. alchemillae* (Fuckel) Schröter = *Trach. intrusa*, *U. alopecuri* Szym. = *U. dactylidis*, *U. astragali* Sacc. = *U. punctatus*, *U. betae* Tul. ex Kickx = *U. beticola*, *U. briardi* Har. = *U. anthyllidis*, *U. caryophyllinus* (Schrank) Winter in Rabenh. = *U. dianthi*, *U. ciceris-arietini* (Grognot) Jacz. = *U. anthyllidis*, *U. coronillae* Vienn.-Bourg. = *U. anthyllidis*, *U. euphorbiae-astragali* Jordi = *U. punctatus*, *U. fabae* de Bary = *U. viciae-fabae*, *U. ferulaginis* Lindroth = *U. ferulae*, *U. festucae* Sydow & H. Sydow = *U. dactylidis*, *U. ficariae* (Alb. & Schwein.) Lév. = *U. ficariae* (Schumacher) Fuckel, *U. flectens* Lagerh. = *U. nerviphilus*, *U. gaeumanni* Mayor & Vienn.-Bourg. = *U. anthyllidis*, *U. genistae* Schröter = *U. laburni*, *U. genistae-tinctoriae* (Pers. : Pers.) Winter = *U. laburni*, *U. guerkeanus* Henn. = *U. anthyllidis*, *U. hyppocrepidis* Mayor = *U. anthyllidis*, *U. hyacinthi* (Opiz) W. Schneider = *U. muscari*, *U. jaapianus* Kleb. = *U. anthyllidis*, *U. kabatianus* Bubák = *U. geranii*, *U. lereddei* Dupias = *U. anthyllidis*, *U. limbatus* (Rabenh.) W. Schneider = *U. muscari*, *U. loti* A. G. Blytt ex Sydow & H. Sydow = *U. euphorbiae-corniculati*, *U. magnusii* Kleb. = *U. anthyllidis*, *U. medicaginis-falcatae* Winter in Rabenh. = *U. striatus*, *U. orobi* Lév. = *U. viciae-fabae*, *U. phaseoli* (Pers. : Pers.) Winter = *U. appendiculatus*, *U. phaseolorum* Tul. = *U. appendiculatus*, *U. poae* Rabenh. in Marcucci = *U. dactylidis*, *U. polygoni* (Pers.) Fuckel = *U. polygoni-aviculariae*, *U. reticulatus* (Thüm.) Bubák = *U. japonicus*, *U. salsolae* Reichardt = *U. polycnemi*, *U. scillarum* (Grev. ex Berk.) Winter in Rabenh. = *U. muscari*, *U. scirpi* (Castagne) Lagerh. = *U. lineolatus*, *U. thapsi* Bubák = *U. verbasci*, *U. trifolii* (R. A. Hedwig ex DC.) Lév. = *U. trifolii-repentis*, *U. trifolii-hybridi* H. Paul = *U. trifolii-repentis*, *U. vesicatorius* (Bubák) Tranzschel = *U. leontices*

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[364], *V. officinalis* [364], *V. tripteris* [364], *Valerianella coronata* [142], *Valerianella* sp. [364], *Velezia rigida* [296], *Veratrum lobelianum* [255, 366], *Verbascum abietinum* [367], *V. lichnitis* [367], *V. thapsiforme* [367], *Veronica montana* [256], *V. orchidea* [256], *V. urticifolia* [257], *Vicia angustifolia* [370], *V. bithynica* [370], *V. cassubica* [338, 370], *V. cracca* [304], *V. ervilia* [312, 365], *V. faba* [370], *V. grandiflora* [370], *V. hirsuta* [298, 370], *V. incana* [304, 370], *V. lathyroides* [284, 370], *V. latifolia* [369], *V. lutea* [312], *V. pannonica* [304, 312, 370], *V. sativa* [298, 304, 370], *V. sepium* [370], *V. tenuifolia* [298, 304, 370], *V. varia* [304, 370], *V. villosa* [304, 370], *Vinca herbacea* [258], *V. major* [258], *Vincetoxicum hirundinaria* [16], *Viola alba* [259], *V. biflora* [73], *V. canina* [259], *V. dacica* [259], *V. hirta* [259], *V. jordanii* [259], *V. kitaibeliana* [126, 259], *V. odorata* [259], *V. reichenbachiana* [259], *V. riviniana* [259], *V. tricolor* [126, 259], *Vulpia myurus* [152]

Xanthium italicum [261], *X. strumarium* [261]

Zea mays [238]

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Macrolepiota molybdites* (Meyer: Fr.) comb. nov., new to the Canary Islands*G. Moreno* , A. Bañares** & M. Heykoop ***

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Summary: A macro - and microscopical description of *Chlorophyllum molybdites*, collected among the grass *Stenotaphrum americanum* Schrank in Tenerife (The Canary Islands), is provided and its formal transfer to *Macrolepiota* is proposed.

Key words: *Macrolepiota molybdites*, *Agaricales*, taxonomy, chorology.

INTRODUCTION

During the "Primer Congreso Nacional de Micología", celebrated in July 1992 in Tenerife (Canary Islands), we intended to collect *Agaricales s. lato*. Unfortunately this was not possible because of the lack of rainfall in the previous months. However, in the "Casino Taoro" gardens, at Puerto de La Cruz, there were some mushrooms growing as a result of irrigation. These fungi were identified as *Chlorophyllum molybdites*, and after having showed them to the personnel of the "Casino Taoro", they told us they have been observing these mushrooms every year during the last years, wondering about whether they were edible or not.

Two main reasons led us to study and describe this species: (1) it is a rare and unreported species to the Canary Islands, and (2) a large amount of carpophores (more than 40) were collected.

***Macrolepiota molybdites* (Meyer: Fr.) G. Moreno, Bañares & Heykoop comb. nov. Figs. 1-2**= *Agaricus molybdites* Meyer, Primitiae Fl. Esseq. 300. 1818.= *Agaricus molybdites* Meyer : Fr., Syst. Mycol. 1:308. 1821.= *Lepiota molybdites* (Meyer : Fr.) Sacc., Syll. Fung. 5: 30. 1887.= *Chlorophyllum molybdites* (Meyer : Fr.) Massee, Bull. Misc. Inf. Kew 135. 1898.= *Lepiota morganii* (Peck) Sacc., Syll. Fung. 5:31. 1887.= *Lepiota esculenta* (Massee) Sacc. & Syd., Syll. Fung. 16:1. 1902.= *Chlorophyllum esculentum* Massee, Bull. Misc. Inf. Kew 135. 1898.= *Lepiota camporum* (Speg.) Speg., Bol. Acad. Nac. Cienc. Córdoba 29:114. 1926.

Material examined: SANTA CRUZ DE TENERIFE (Canary Islands): Puerto de la Cruz, "Casino Taoro" (100 m above sea level), in a lawn among *Stenotaphrum americanum* Schrank (*Poaceae*), 8-VII-1992, leg. G. Moreno (AH) 15.078; Duplic. in TFC Mic 6445.

Our material agrees well with REID & EICKER 's (1991) description of this species, except there are two noteworthy differences: (1) the stipe is wider at the base (bulbous-like), and (2) the spores are somewhat longer than those described by these authors.

Pileus 7-20 cm in diameter, globose to broadly-convex, umbonate, applanate when mature, margin incurved. Epicutis brown-ochraceous, broken into large plaques or scales from the margin to the middle of the pileus, and exposing its whitish subcutis. Stipe 5-25 x 1-2 cm, cylindrical, straight or slightly curved, bulbous (up to 4 cm in diameter), whitish to cream-coloured, with a whitish mobile annulus located at the apex. Gills free, crowded, wide, with lamellulae; colour changing according to the stage of development and the dryness of tissues: when young cream-coloured, acquiring greenish shades at maturity and showing gray-olivaceous colours in exsiccata. Trama reddish-white when cut or bruised. Smell and taste none. Epicutis a trichoderm consisting of cylindrical hyphae, compressed and sometimes branched (e.g. 35 x 7 μ m). Spores 9.5-12 x 6-8 μ m, amyloid, broadly ellipsoid, with thick yellowish-hyaline walls, metachromatic in cresyl blue, apex truncate and often showing an apical and central germ pore. Basidia tetrasporic (e.g. 23 x 9 μ m). Cheilocystidia 25-35 x 10-15 μ m, forming a sterile band at the edges, hyaline to ochraceous, globose to pyriform with a narrow base. Neither pleurocystidia nor clamp connections have been observed.

OBSERVATIONS: *Chlorophyllum molybdites* is a new record for the mycoflora of the Canary Archipelago. It is a poisonous species whose effects may vary considerably from one person to another. Because of its similarity with *Macrolepiota rhacodes* (Vitt.) Singer, we examined local material of the latter (Herbarium TFC Mic 2.016, 3.956 and 6.450), coming from "Laurisilva forest", and its identification has been confirmed. Therefore, we have eliminated the possibility that previous records of *Macrolepiota rhacodes* (collected in the Canary Islands) could have been misinterpreted and confused with *C. molybdites*.

Chlorophyllum Masee non Murrill, of Singer's tribus *Leucocoprineae*, shows great macro- and microscopical similarities with *Macrolepiota* Singer especially with *M. rhacodes* (Vitt.) Singer. According to SINGER (1986), *Macrolepiota* differs from *Chlorophyllum* because the latter presents the following characters: greenish spore print, rare clamp connections, spores indistinctly metachromatic when stained with cresyl blue, poisonous properties and a mainly tropical and subtropical distribution. However, we think these features does not define and characterize *Chlorophyllum* as a distinct genus. The green colour (pileus, stipe and gills) has also been observed in *Macrolepiota olivascens* Moser ex Moser & Singer, and the absence or presence of clamp connections is variable according to different authors. Moreover, several poisoning cases due to species of *Macrolepiota* (*M. rhacodes* and *M. venenata*) have been reported in the mycological literature. Finally, SINGER (1986) indicates that *Chlorophyllum* has spores which are often not so clearly metachromatic as those from *Macrolepiota*, and that the distinction of both genera by the capacity of the spore wall to absorb Congo red, as pointed out by WERESUB (1971), is even sharper. Nevertheless similar chemical differential reactions can be found in taxa belonging to *Amanita*, *Mycena* or *Gymnopilus*.

On the other hand the micro- and macroscopic morphological similarity between *Macrolepiota* and *Chlorophyllum* supports their synonymy. All these reasons have led us to combine *C. molybdites* to *Macrolepiota* and to create the new section *Chlorophyllum* sect. nov.



Fig.1.- *Macrolepiota molybdites* AH 15078. a-b: epicutis; c-e: cheilocystidia; f-g: spores.

Section *Chlorophyllum* sect. nov.: *Differt sporis in cumulo et lamellis colorem viridem accipientibus maturitate. Typus sp.:* *Macrolepiota molybdites* (Meyer : Fr.) Moreno, Bañares & Heykoop.

An extensive work on *Chlorophyllum molybdites*, realized recently by REID & EICKER (1991), including a very rigorous chorological revision, gives us some extra information about its poisonous properties. Besides, these authors have a broad concept of this species including also *C. molybdites* var. *congolensis* (Beeli) Heinemann as a synonym, despite the fact that the latter has smaller spores and a brighter sporeprint (HEINEMANN, 1967). This species can be found on rich soils (gardens, plantations, lawns, etc.) and is widely distributed throughout the world, being more abundant in the tropics, with New Zealand representing its southern and North England its septentrional limit (SINGER, 1986; REID & EICKER, 1991; GUZMAN & GUZMAN-DAVALOS, 1992). It is also worth to mention its abundance in North America (PHILLIPS, 1991). This species has been reported in Europe by SINGER (1946), VELLINGA (1990) and WATLING (1991), always in relationships with exotic introduced plants. Our collection from the Canary Islands shows it is an allochthonous taxon, which has been introduced with the "American lawn-grass" *Stenotaphrum americanum*.

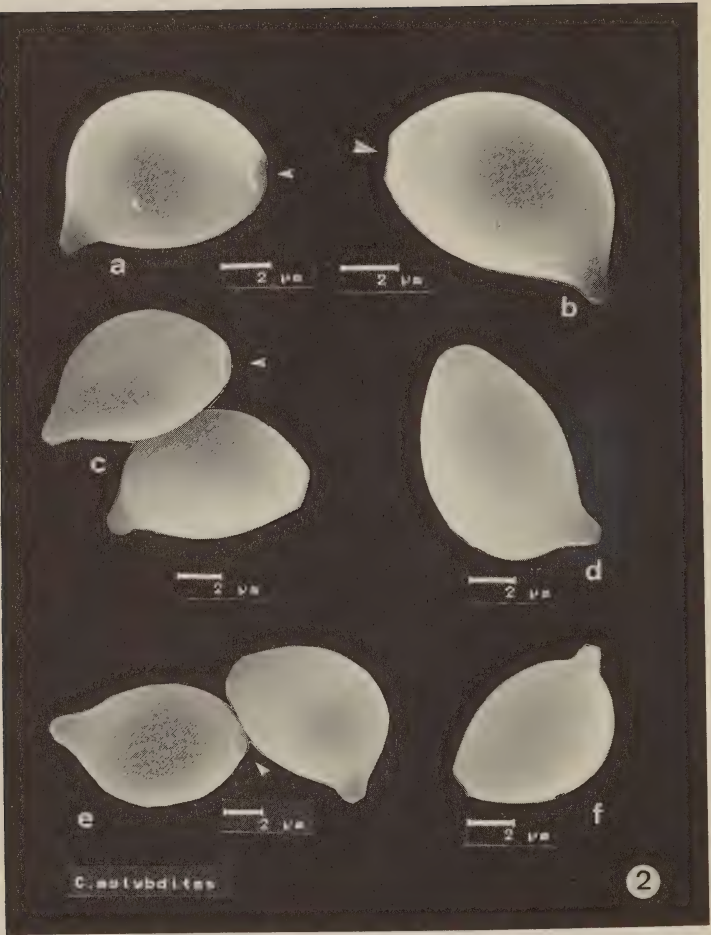


Fig.2.- *Macrolepiota molybdites* AH 15078. a-f: spores with central germ pore under SEM (with critical point technique).

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CONIDIAL FUNGI FROM LEAF LITTER IN A MESOPHILIC CLOUD FOREST OF VERACRUZ, MEXICO

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ABSTRACT

An account of twenty three species of conidial fungi colonizing decaying leaves of *Liquidambar macrophylla*, *Quercus xalapensis* and *Quercus germana* is presented. Leaf samples were collected from a cloud forest in the state of Veracruz. Field collections were studied using damp chambers. Information about their distribution in the neotropical region and comparative information about their previous substrates is presented.

INTRODUCTION

In the last decades literature concerning with floristic studies of conidial fungi from tropical environments have increased (Rambelli et al., 1983; Mercado-Sierra, 1984; Castañeda-Ruiz & Kendrick, 1990;

Matsushima, 1993). However, the mycota of most of the tropical regions is still largely unknown.

The saprobic microfungi of mexican forests, are as yet, poorly known. Because of its geographic location, Mexico is a transition area between the nearctic and the neotropical regions. Among the mexican vegetation types included in the neotropical region are the cloud forests, which have a mixture of tropical and temperate tree species (Puig, et al. 1987).

Due to their special climatic features and their high leaf litter accumulation on the forest floor, cloud forests are exceptional ecosystems for the study of leaf litter fungi. Recently initial survey have been conducted to characterize the hyphomycete flora associated with leaf litter and to assess species dominance and succession during the process of leaf decomposition (Heredia, 1993, 1994) in cloud forest.

Presently most of the cloud forests in Mexico have been cleared. In the state of Veracruz this vegetation type remains only in very few scattered patches (Castillo-Campos, 1991), and thus, are vestigages of an endangered habitat.

This contribution is intended to provide new information on host associations and fill previous gaps in distributional knowledge of hyphomycetes in forests of the neotropical region.

STUDY AREA

The study area is located in a forest adjacent to Xalapa, within the Rancho Guadalupe at the 2.5 km on the old road Xalapa-Coatepec ($19^{\circ} 21'N$, $96^{\circ} 57'W$), and at an altitude of 1225m. The annual mean temperature is $18.4^{\circ}C$, with a total annual rain-fall of 1957 mm, and mean annual relative humidity above 80%.

The canopy and subcanopy are composed of the following dominant trees; *Liquidambar macrophylla* Oersted, *Carpinus caroliniana* Walter, *Quercus germana* Cham. & Sch. and *Q. xalapensis* Humb.. Litterfall biomass is estimated at 9.2 ton/ha/year, with leaves being the main component of the litter. The species with the greatest contributions to the forest litter are *L. macrophylla*, *C. caroliniana*, *Q. germana* and *Q. xalapensis* (Correa, 1981).

MATERIALS AND METHODS

Collections of leaf litter of *Liquidambar macrophylla*, *Quercus germana* and *Q. xalapensis* were made at different seasons during 1990-1994. Leaf disks were incubated in damp chambers at 25-28°C. Microscopic examination was made after 6-15 days. Permanent slides were mounted in polyvinil alcohol. Specimens are deposited in the Herbarium of the Instituto de Ecología of Xalapa (XAL). Species are listed in alphabetical order, those preceded by an asterisk are new records for Mexico.

DESCRIPTION OF SPECIES

* *Anungitea fragilis* Sutton, 1973, Mycological Papers 132:10-13.

Conidiophores erect, straight, smooth, pale brown to mid brown, 2-4 septate, 37 μm long x 2-4 μm wide at the base. *Conidiogenous cells* polyblastic, integrated, swollen apically with denticles, 9-17 μm x 2-3.5 μm wide. *Conidia* catenate, cylindrical, formed in short unbranched chains, very pale, 1-septate, smooth, with scars at each end, 9-11 μm long x 1-1.9 μm wide.

Material examined. On decaying leaves of *Liquidambar macrophylla* and *Quercus germana*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB607/ 30 Apr. 1993. *G. Heredia* CB608XAL/ 20 Dec. 1991.

Although our conidial measurements are somewhat smaller than those of Sutton (1973), other characteristics of the xalapen specimens, including the unbranched acropetal conidia chains, agree with the type description.

The species is known from different kinds of plant debris, it has been collected mainly in temperate biomes (Kirk, 1982a, 1982b, 1983), and seems to be wide spread throughout the American continent, being known from Canada (Sutton, 1973) and from the antarctic region of Argentina (Gamundí et al., 1977). This report, together with that from Hawaii (Kirk, 1982a) indicate that this fungus also has tropical affinities.

* *Ceratosporella deviata* Subram., 1957, Proc. Indian Acad. Sci., Sect. B. 46: 327.

Conidiophores cylindrical, dark brown, septate, up to 255 μm long x 5-10 μm wide at the base. *Conidiogenous cells* doliiiform 17-20 μm long x 2.5 μm wide. *Conidia* mid brown, basal cell pyriform, 10-13 μm long x 5-8 μm thick in the broadest part, 2-3 μm at the base and 2 divergent arms, subulate, 4-7-septate, up to 60 μm long x 5-6 μm at the base.

Material examined. On decaying leaves of *Quercus germana*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB 602XAL/ 20 Dec. 1991,

All the conidia observed have 2 arms, this feature resembles *C. novae-zelandiae* Hughes and *C. bicornis* (Morgan) Hohnel, however, the morphology and measurements of the conidiophores and conidia match perfectly with *C. deviata* (Ellis, 1976).

Reports of this species are rare, being known from original locality, India, on dead leaf bases of *Raphiostyles sapida* (Ellis, 1976). This appears to be the first record for the neotropical mycoflora.

* *Dactylella ellipsospora* Grove, 1886, J. Bot., Lond. 24:200.

Conidiophores simple, hyaline up to 250 μm x 3.5-5 μm wide at the base. *Conidia* fusiform, distally rounded, proximally attenuated, hyaline, 4-septate, median cell largest, 39-45.5 μm long x 9-15 μm wide.

Material examined. On decaying leaves of *Quercus germana*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB586XAL/ 1 Feb. 1992.

This species is a nematode-capturing fungus (Drechsler, 1937). The xalapan specimens agree in all respects with previous accounts (Cooke, 1964; Matsushima, 1971). It has been collected from forest litter from Asia (Matsushima, 1971, 1975, 1980). In the neotropical region had been reported before from Peru, on decaying palmar-petioles and tree leaves (Matsushima, 1993).

* *Dictyochaeta assamica* (Agnihotrudu) Arambarri, Cabello & Mengascini, 1987, Mycotaxon 29: 29-35.

Setae erect, straight or slightly curved, smooth, dark brown, up to 300 μm long, 4-6 above the base, tapering to about 2-3 μm in the apical region. *Conidiophores* erect, unbranched, arising in groups of up to 5, brown at the base, 3-6 septate, 40-108 μm long x 3-5 μm wide above the swollen base. *Collarettes* terminal and lateral, funnel-shaped, thin-walled, 1.5-4 μm wide and 1-2 deep. *Conidia* hyaline, curved, non-septate, 12-17 μm long x 1.5-2.5 μm , with a setula at each end of the conidia, 5-10 μm long.

Material examined. On decaying leaves of *Quercus germana*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia CB573XAL/* 19 Sept. 1991.

Known from various kinds of plant debris. Most of the records for this species are confined to the palaeotropical region (Hughes & Kendrick, 1968; Ellis, 1971; Kuthubutheen & Nawawi, 1991). In the Northeastern of Mexico it was collected before on green and decaying leaves from a cloud forest (Heredia, 1993).

* *Dictyochaeta simplex* (Hughes & Kendrick) Hol-Jech., 1984, *Folia Geobot. Phytotax.* 19:434.

Setae absent. *Conidiophores* unbranched, straight, cylindrical, pale brown to brown, septate, up to 100 μm long x 2.5-5 μm wide. *Collarettes* funnel-shaped, subhyaline to pale brown, 2-4 μm wide and 2-2.5 μm deep. *Conidia* hyaline, curved, aseptate, fusiform, 11-18 μm long x 1.5-2.5 μm wide at the broadest part, setulae at both ends, 5-8 μm long.

Material examined. On decaying leaves of *Quercus xalapensis*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia CB574XAL/* 21 Sep. 1991.

This species is widespread on decaying leaves of various plants from tropical and temperate biomes (Mouchacca and Zucconi, 1994). In Mexico *D. simplex* has been isolated also in decaying *Quercus* leaves from a cloud forest in Tamaulipas state (Heredia, 1993). *Dictyochaeta coffeae* was described by Maggi and Persiani (1984) near the study area. Both species are very close, but differ in the conidia shape and size.

For the neotropical region, reports exist from Brazil, on *Eucalyptus* leaves (Sutton & Hodges, 1975) and from Cuba on a dead leaf of *Calophylla antillanum* (Castañeda, 1986).

* *Dictyosporium heptasporum* (Garov.) Damon, 1952, Lloydia 15:118

Colonies effuse, blackish brown. *Hyphae* pale brown, 2-4 μm in diam. *Conidia* olivaceous brown, broadly ellipsoidal, not flattened, 41-55 μm long x 16-22 μm wide at the broadest part, consisting of 7 rows, each row with an incurved hooked end, cells 5- μm wide.

Material examined. On decaying leaves of *Quercus xalapensis*. Rancho Gpe., Xalapa, Ver., Mexico. G. Heredia CB606XAL/ 17 Aug. 1992.

Conidial dimensions of xalapán material are smaller than those reported in the literature (Ellis, 1971; Matsushima, 1971, 1993) excepting Matsushima (1980).

This species has been recorded mainly from the tropics, isolated from air and a wide variety of plant debris (Ellis, 1971). Known in the neotropical region from Costa Rica on bark (Morris, 1972), Belize, on dead woody branch (Morris, 1978), Cuba, on dead petioles of *Roystonea regia* and dead branches (Holubová-Jechová, 1989; Mercado-Sierra, 1984) and from Peru and Ecuador, on decaying banana leaves and Palmae-petioles (Matsushima, 1993).

**Gonytrichum macrocladum* (Sacc.) Hughes, 1951, Trans. Br. mycol. Soc. 34: 565-568.

Conidiophores simple, erect, pale brown, up to 340 μm long x 7-11 μm at the base, 4-6 μm thick above the base, tapering subulately, 1-2.5 μm wide at the apex. Conidiogenous cells phialidic, subulate, subhyaline-pale brown, borne directly on the conidiophore in whorls of 3-5, 10-15 μm long x 2-3 μm wide. *Conidia* ellipsoidal or subspherical, pale, 2-4 μm long x 1-2 μm wide, accumulating in a slimy masses.

Material examined. On decaying leaves of *Quercus xalapensis*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB547XAL /17 Aug. 1992.

The conidiophores of the xalapen material did not have apical setae, which are not always produced in this species (Hughes, 1951). Shape and size of the conidiophores and conidiogenous cells agreed with the original description, but conidia were slightly smaller.

This is a widespread species isolated from soil and plant debris (Hughes, 1951). Reports for the neotropical mycoflora come from Cuba, on dead rotten trunk of *Ficus* sp (Holubová-Jechová & Mercado-Sierra, 1984), Jamaica (Ellis, 1971), and Panama, isolated from soil (Farrow, 1954).

* *Gyrophthrix circinata* (Berk. & Curt.) Hughes, 1958, *Canad. J. Bot.* 36:771.

Setae numerous, intertwined, thick-walled, dark brown, rough, circinate, 2-4 times branched, 90-125 μm long x 4-5 μm wide at the base. *Conidiogenous cells* obclavate, subhyaline 6-8 μm long x 2.5-4 μm at the base. *Conidia* fusoid, slightly curved, hyaline, 10-13 μm x 1-1.5 μm .

Material examined. On decaying leaves of *Liquidambar macrophylla*. Rancho Gpe., Xalapa, Ver., Mexico, *G. Heredia* CB592XAL/ 10 Dec. 1991.

This species is wide spread, mainly in tropical biomes (Pirozynski, 1962, Matsushima 1980). Neotropical specimens have been reported from Belize (Morris, 1978) and Cuba frequently growing on dead palmae-leaves and petioles (Mercado-Sierra, 1984; Holubová- Jechová & Mercado-Sierra-Sierra, 1989).

* *Helicosporium griseum* Berk. & Curt., 1874, *Grevillea* 3:51.

Colonies cottony, pale pinkish-grey. *Conidiophores* forming networks, up to 200 μm long x 5-6 μm at the base. *Conidia* hyaline, helically coiled 3-3.5 times, borne on denticles 5-6 μm x 2 μm , coiled conidia 17-21 μm in diam., filaments 1-2 μm in diam.

Material examined. On decaying leaves of *Quercus germana*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB591XAL/ 25 Mar. 1992,

This species has been isolated from decaying wood and plant litter from tropical and temperate biomes (Goos, 1989; Matsushima, 1971). In the neotropical region it has been reported from Cuba, on the petiole of a dead leaf of *Roystonea regia* (Mercado-Sierra, 1984).

* *Helicosporium virescens* (Pers.) Sivanesan, 1984, Bitunicate Ascomycetes. 591-592. State of *Tubeufia cerea* (Berk. & Curt.) Booth, 1964, Mycol. Pap. 94:11-13.

Conidiophores 96-210 μm long x 4-5 μm at the base. *Conidia* hyaline, greenish yellow in mass, helically coiled 2-times, 13-15 μm diam, with filaments 1 μm in diam.

Material examined. On decaying leaves of *Quercus germana*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB590XAL/ 16 Jul. 1991.

Ellis (1971) referred to this species as common on dead wood and bark lying on the ground. It has been reported mainly in temperate areas. Collections from Guyana (Goos, 1989) and this report extend its distribution to the neotropical region.

* *Isthmotricladia gombakiensis* Nawawi, 1975, Trans. Br. mycol. Soc. 64: 243-246.

Conidia very pale 4-6-radiate, with a main axis, 18-22 μm long x 2-3 μm wide at the apex, tapering gradually at the base. The arms are fusiform, 62-83 μm long x 4-5 μm at the widest point, 8-13 septate. Isthmus, 3-5 μm long x 1.5-3 μm wide.

Material examined. On decaying leaves of *Quercus germana*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB593XAL/ 25 Mar. 1992.

We were unable to find conidiophores in our specimens. According to the original description, conidiophores are indistinguishable from the somatic hyphae and deficient (Nawawi, 1975). A characteristic of "terrestrial aquatic fungi" is that they often have micronematous conidiophores or lack conidiophores (Ando, 1992).

This species has been scarcely reported. The type specimen is from Malaysia found in foam and scum samples collected on Gomabak River (Nawawi, 1975). Later it was isolated from dead leaves of *Clusia minor*, from Cuba (Matsushima, 1985).

* *Nakataea fusispora* (Matsushima) Matsushima, 1975, *Icones microfungorum a Matsushima lectorum*, Kobe: 100.

Conidiophores unbranched, straight, pale brown, smooth, 38-47 μm long x 3-5 μm wide at the base. *Conidiogenous cells* polyblastic, integrated, sympodial, denticulate. *Conidia* solitary, dry, verrucose, fusiform, 3-septate, the cell at each end hyaline or very pale brown, intermediate cells pale to mid-pale brown, 25-30 μm long x 4-5 μm wide.

Material examined. On decaying leaves of *Quercus germana*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia CB594XAL/* 20 Dec. 1991.

This species has been isolated from soil and different types of dead leaves from the oriental and australian regions (Matsushima, 1971, 1975; Mouchacca, 1990). In the neotropical region has been reported from Cuba, on dead leaves of *Jambosa vulgaris* (Castañeda-Ruiz & Kendrick, 1990) and from Peru and Ecuador, on decaying palmae-petioles and decaying leaves (Matsushima, 1993).

Pithomyces chartarum (Berk. & Curt.) M. B. Ellis, 1960, *Mycol. Pap.* 76:13-15.

Conidiophores pale olive, 2-3 μm thick. *Conidia* broadly ellipsoidal, with 3 transverse septa and one longitudinal which divides the middle cells, mid to dark brown, verrucose, 17-26.5 μm long x 10-13 μm wide.

Material examined. On decaying leaves of *Liquidambar macrophylla*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB597XAL/ 13 Jul. 1993.

This ubiquitous cosmopolitan fungus has been isolated from soil, air and plant debris (Ellis, 1971). From the neotropical mycoflora, it has been isolated from soil in Honduras (Goos, 1963), and in Belize, from dead herbaceous stems (Morris, 1978). In Mexico, it was collected before on leaf litter from a coffee plantation (Onofri, 1984).

* *Pithomyces maydicus* (Sacc.) M.B. Ellis, 1960, Mycol. Pap. 76:15.

Conidia broadly ellipsoidal, with 2 transverse septa and one longitudinal which divided the middle cell, mid to dark brown, verrucose, 15-18 μm long x 8-10 μm wide.

Material examined. On decaying leaves of *Liquidambar macrophylla* and *Quercus xalapensis*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB595XAL /5 Oct. 1993; *G. Heredia* CB596XAL /5 Oct. 1993.

Common on plant debris and soil, with a wide distribution mainly in tropical biomes (Ellis, 1971; Matsushima, 1975, 1980, 1981, 1989). Although it might be wide-spread in the neotropics, there are only few reports from Guyana, Jamaica and Costa Rica (Ellis, 1971; Bills & Polishook, 1994).

Selenosporella curvispora MacGarvie, 1968, Scient. Proc. R. Dubl. Soc., Ser. B, 2(16): 153-158.

Conidiophores erect, straight, with branches arising along the axis, dark brown at the base, mid brown at the apex, up to 230 μm long x 8-12 μm thick at the base. *Conidiogenous cells* hyaline, polyblastic, flask shaped, apically swollen and finely denticulate, arising either directly from the conidiophore axis or from branches, 8-13 μm long x 3-4.5 μm wide at the base. *Conidia* fusiform, with a sharply pointed apex, smooth, hyaline, slightly curved, non-septate, 5-8 μm long x 0.5-0.8 μm wide.

Material examined. On decaying leaves of *Quercus germana*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB598XAL/30 Apr. 1993.

This fungus is associated with many species of decaying leaves. It is known from the Palearctic and Oriental regions (Ellis, 1971; Matsushima, 1975; Kirk, 1982a; Matsushima, 1989) but has been scarcely recorded from the neotropical mycoflora. In Mexico, it was collected, colonizing *Coffea arabica* leaf litter (Maggi & Persiani, 1990).

* *Spegazzinia deightonii* (Hughes) Subram., 1956, J. Indian bot. Soc. 35:78.

Conidiophores with *a* conidia up to 185 μm long x 2 μm thick at the base, 3-5 μm at the apex. *Conidia*: *a* conidia divided into 8 subglobose cells, dark brown, with spines, 19-21 μm diam. excluding spines which are up to 6 μm long; *b* conidia ellipsoidal, lobulate, flattened in one plane, pale to mid brown, muriform, 8-celled, 17-20 μm long x 14- 15 μm wide, a small denticle remains attached to one side of the base of the conidia.

Material examined. On decaying leaves of *Quercus xalapensis*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB582XAL/ 9 May. 1992.

Conidiophores with *b* conidia were not found. Size of *b* conidia are smaller than the reported in literature (Ellis, 1971). However the peculiar morphology of this species makes it unmistakable. This species is known mainly in tropical biomes. In the neotropical region it has been reported in Puerto Rico (Ellis, 1971), and Cuba on leaves of *Andropogon glomeratus* (Mercado-Sierra, 1984). Up to now, most of its known substrates were monocots (Hughes, 1953).

* *Sporidesmium filiferum* Pirozynski, 1972, Mycol. Pap. 129: 55-57.

Conidiophores straight, septate, 51-63 μm long x 4-5 wide, with 0-5 annellations. *Conidia* pale brown, obclavate, truncate at the base, 6-7 septate, 26-37 μm long x 8-9 μm thick at the widest part, 3-5 μm wide

at the base. Terminal hyaline appendage up to 70 μm long, most of the spores without the appendage.

Material examined. On decaying leaves of *Liquidambar macrophylla*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia CB581XAL/* 15 Feb. 1993.

Very few of the spores observed have appendages, but Matsushima (1983) noted that the appendages are frequently lost after maturation.

This fungus is associated with different decaying leaves. Previous records suggest that it is a tropical fungus (Pirozynski, 1972; Matsushima, 1983, 1989). This is the first record for the neotropical mycoflora.

* *Tetracoccusporium aerium* Misra & P. Srivastava, 1976, Mycotaxon 4(1):276-278.

Mycelium subhyaline, hyphae 1-2 μm diam. *Conidiophores* light brown, smooth, 1-septate, with the septum near the apex, 5-9 μm long x 1.5-2 μm wide. *Conidia* acrogenous, sphaerical or ellipsoidal, divided, cruciately, dark brown minutely, verruculose, 4-celled, 9-10 μm diam. x 7-10 μm wide.

Material examined. On decaying leaves of *Quercus germana*. Rancho Gpe., Xalapa, Ver.. Mexico. *G. Heredia CB575XAL/*21 May 1991.

The type species was isolated from air (Misra & Srivastava, 1976) in India. This represents the first record for the neotropical mycoflora.

* *Teratosperma singulare* Sydow, 1909, Annls mycol. 7:172-173.

Hyphae 2-3 μm thick. *Conidiophores* straight, pale to mid brown, 19-26 μm x 6-8 μm wide. *Conidiogenous cells* integrated, terminal, percurrent. *Conidia* acrogenous, appendiculate, mid to dark brown, obclavate, truncate at the base, 8-9-septate, 100-126 μm long x 15-17 μm wide in the broadest part, 7-9 μm wide at the base; 1-3 lateral appendages

arising from the proximal cell, subulates, 0-3 septate, up to 59 μm long x 5-7 μm wide at the broadest part.

Material examined. On decaying leaves of *Liquidambar macrophylla*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia CB601XAL/* 8 Feb. 1994.

Teratosperma singulare has been scarcely reported, records are from Japan, on leaves of *Ulmus* and on bark and dead log of *Fagus crenata* (Ellis, 1971; Matsushima, 1975). This is the first record for the neotropical mycoflora.

* *Triramulispora gracilis* Matsushima, 1975, *Icones Microfungorum* a Matsushima Lectorum. p. 158.

Conidia very pale, with a main axis and three arms obclavate. Main axis 2-3-septate, 25.5-27.5 μm long x 2-3 μm at the widest part, base truncate, 1-1.5 μm wide. Arms hyaline, 0-3 septate, 12-18 μm long x 1.5-2 μm at the widest part, tapering distally, connected to the main axes by a very narrow filament 0.5-1 μm long x 0.5 μm wide, imperceptible in some conidia.

Material examined. On decaying leaves of *Quercus xalapensis*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia CB610XAL/* 1 Feb. 1992.

Conidia shape in our specimens are quite similar to that of the type description (Matsushima, 1975). Dimensions of the main axis and arms are smaller. This species was described from decaying leaves collected in Japan. Apparently this is the first record for the neotropical mycoflora.

* *Tripaspermum myrti* (Lind) Hughes, 1951, *Mycol. Pap.* 46:17-18

Hyphae pale brown, 2.5-5 μm in diam., cells doliiform. *Conidiophores* straight, unbranched, medium brown, up to 50 μm long x 4-9 μm wide. *Conidia* with stalk cell 6-8 μm long x 4-6 μm wide, arms up to 25 μm long x 6-7 μm wide at the base, tapering 1-3 μm , 2-3-septate constricted at the septa.

Material examined. On decaying leaves of *Quercus xalapensis*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB600XAL/ 13 Jul. 1993.

Known from different types of plant debris, in both tropical and temperate biomes (Ellis, 1971; Matsushima, 1971; Matsushima, 1980). In Mexico it has been collected before on green leaves of *Quercus* and *Liquidambar* (Heredia, 1993) from Tamaulipas state.

Ulocladium atrum Preuss, 1852, *Linnaea* 25:75

Conidia dark reddish brown, verrucose, cruciately septate, ellipsoidal, 10-20 μm long x 8-12 μm wide, or subspherical, 12-16 μm diam..

Material examined. On decaying leaves of *Liquidambar macrophylla*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB611XAL/ 13 Jul. 1993.

Ulocladium atrum is common on dead wood, stems, soil, seeds and leaves of many different plants (Ellis, 1971). It is a cosmopolitan species. Although it has scarcely been recorded, it is surely widespread in the neotropical region. Near our collecting area, it was isolated from rhizosphere soil from a coffee plantation (Persiani & Maggi, 1988).

* *Veronaea coprophila* (Subram. & Lodha) M. B. Ellis, 1964, *Antonie van Leeuwenhoek* 30:317-319

Conidiophores straight, medium to dark brown, apex with small, flat scars, up to 280 μm long x 3-4 μm wide. *Conidia* pale brown, smooth, cylindrical rounded at the apex, conico-truncate at the base, 1-septate, smooth, 8-12 μm long x 3-4 μm wide.

Material examined. On decaying leaves of *Quercus xalapensis*. Rancho Gpe., Xalapa, Ver., Mexico. *G. Heredia* CB572XAL/ 21 Mar. 1991.

This species was first isolated from goat dung from India (Ellis, 1971). Close to our collecting localities, a *Veronaea* sp. has been isolated

from leaf litter and rhizosphere soil (Onofri, 1984; Persiani & Maggi, 1988).

BIOGEOGRAPHIC OBSERVATIONS

Most of the species listed above have been reported from other plant host and many have widespread geographic distributions, therefore indicating they are generalist with regard to host specificity. However, these fungi may exhibit a degree of specialization for the stage of the decomposition at which their conidiophores develop.

Several species among these fungi could be considered "terrestrial aquatic hyphomycetes" (Ando, 1992) because they have modified conidial appendages or arms like Ingoldian hyphomycetes. The frequency of hyphomycetes with these specialized conidial forms may be an adaptation to local dispersion in the cloud forest environment with its constant elevated relative humidity and persistent films of water on surfaces of the vegetation.

Of the species presented above, most of them have geographic distributions with tropical affinities; 13 species are generally restricted to the tropics, 10 are from both tropical and temperate biomes, but none are species restricted to temperate climates. Considering that the mesophilic forest of Veracruz consist of both tropical and temperate tree genera, then a similar mixture of temperate and tropical decomposer hyphomycetes, as we have observed, would be expected. Continued explorations of the communities of microfungi on other plant-related substrata in the mesophilic cloud forest is needed to understand biogeographic patterns of fungi in this unique, but receding habitat.

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NEW SPECIES OF DEMATIACEOUS HYPHOMYCETES FROM VERACRUZ, MEXICO.

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ABSTRACT

Five new species of hyphomycetes belonging to genera *Acremoniula*, *Bactrodesmium*, *Camposporium*, *Endophragmiella*, and *Monodictys* are described and illustrated. All the species were found on plant debris collected in the state of Veracruz, Mexico. The specimens are deposited in the Herbarium of the Instituto de Ecología (XAL).

INTRODUCTION

The state of Veracruz has very diverse vegetation. Most studies on its biodiversity have dealt with the flora, fauna and macroscopic fungi, however hyphomycetes of the region remain poorly explored. In order to evaluate the hyphomycete diversity in the tropical areas of Veracruz the authors have made collecting trips. The following five dematiaceous hyphomycetes were collected from plant debris, mainly leaf litter from cloud forest and tropical rain forest. Based on their distinctive morphological characteristics, they are proposed as new species. All the specimens are deposited in the Herbarium of the Instituto de Ecología (XAL).

SPECIES DESCRIPTION

Acremoniula triseptata Mercado, Heredia et Mena sp. nov.
(Fig. 1)

Coloniae effusae, granulosaе, atrobrunneae vel brunnea, inconspicuae. *Mycelium* partim in substrato immersum sed plerumque superficiale ex hyphis subhyalinis, laevibus, septatis, ramosis, 1.5-2.5 μm latis (diam.) compositum. *Conidiophora* micronemata vel semimacronemata, interdum leviter ascendencia, solitaria vel 2-6 fasciculata, subhyalina vel pallide brunnea, laevia, septata, usque ad 14 μm alta et 2.8-3.5 μm lata. *Cellulae conidiogenae* in conidiophoris incorporatae, terminales, determinatae, 3.5-4.5 μm longa et 1.8-2 μm lata. *Conidia* solitaria, ellipsoidea vel obovoidea, ad basim truncata, transversaliter 3-latisepitata, brunnea vel atrobrunnea. *Cellula basalis* hyalina vel pallidissima; ceterae brunneae nonnihil atrae 9.5-12 x 5.6-6.5 μm . **Holotypus:** 29/III/1993. G. HEREDIA. CB616 (XAL).

Colonies effuse, granular, dark brown to black, inconspicuous. Mycelium mostly superficial, composed of branched, smooth, septate, subhyaline hyphae, 1.5-2.5 μm thick. **Conidiophores** micronematous or semi-macronematous, sometimes lightly ascending, solitary or arising in groups of 2-6, subhyaline to pale brown, smooth, septate up to 14 μm long and 2.8-3.5 μm wide. **Conidiogenous cells** integrated, terminal, determinate, 3.5-4.5 μm x 1.8-2 μm . **Conidia** solitary, ellipsoidal or obovoid, truncate at the base, 3-septate with black bands at the septa, dark brown, 9.5-12 x 5.6-6.5 μm , with the basal cell paler and often hyaline. **Habitat:** Cloud forest. On fallen, decaying leaves of *Quercus germana*. Xalapa, Veracruz. **Material examined:** 29/III/1993. G. HEREDIA. CB616 (XAL).

Discussion. Hughes (1979) extended the circumscription of *Acremoniula* Ciferri (Ellis, 1971), when he transferred *Endophragmia*

Fig. 1-3. 1. *Acremoniula triseptata*. Conidiophores with conidia attached, and mature 3-septate conidia with black bands at the septa. 2. *Bactrodesmium palmicola*. Conidia, showing the very large apical cell and verrucose wall. 3. *Camposporium quercicola*. Conidiophores, conidiogenous cells and conidia with setula.



brevis Ellis, a species with 2 transverse septa, as *Acremoniula brevis* (Ellis) Hughes. Later, Kirk (1985) reported *A. brevis* on dead leaves of *Ocotea usambarensis* from Kenya and discussed and illustrated its conidiogenesis and conidial succession. Based on Kirk's observations, the new species, *Acremoniula triseptata*, has a close affinity with *A. brevis* in morphology, maturation and conidial secession. However it differs from *A. brevis* in the narrower ellipsoidal shape and size of the conidia and by its consistently 3 transverse septa.

Bactrodesmium palmicola Mercado, Heredia et Mena, sp. nov.
(Fig. 2)

Sporodochia punctiformia, sparsa vel aggregata et saepe dispersa, atra, nitida, nigra. *Mycelium* plerumque in substrato immersum interdum superficiale, hyphis brunneis, septatis, laevibus, usque 2.5-4.5 μm crassis (diam.). *Conidiophora* brevissima, 6-11 x 3.8-5.5 μm . *Cellulae conidiogenae* incorporatae, terminales, determinatae, cylindricae. *Conidia* brunnea vel atrobrunnea, obovoidea, claviformia vel ellipsoidalia, transversaliter 3-4 atroseptata, septis ad basem approximatis. *Cellula apicalis* grandis, nigra, ceterae perpusillae, brunneae. *Cellula basalis* pallidior, truncata. *Parietes conidiorum* rugosi, 22-44 x 15.2-22 μm . **Holotypus:** 15/VIII/1993. A. MERCADO. CB064 (XAL).

Sporodochia punctiform, shiny black, scattered or in groups. ***Mycelium*** mostly immersed, occasionally growing superficially on the substratum with hyphae pale brown, septate, smooth, 2.5-4.5 μm thick. ***Conidiophores*** very short, narrow, smooth, 6-11 x 3.8-5.5 μm . ***Conidiogenous*** cells integrated, terminal, determinate, cylindrical. ***Conidia*** obovoid, clavate or ellipsoidal, 3-4 transverse septa forming dark bands, the apical cell very large and black, the other cells brown and smaller, basal cell paler and truncate, wall verrucose, 22-44 x 15.2-22 μm . **Habitat:** Tropical rain forest. On dead rachis of a palm. Papantla, Veracruz. **Material examined:** 15/VIII/1993. A. MERCADO. CB064 (XAL).

Discussion. Species of *Bactrodesmium* are typically saprophytic, producing small sporodochia, sparsely scattered on the substratum. *B. palmicola* has certain features in common with *B. microleucurum* (Ellis,

1965) known from Chile on *Chusquea cummingii*. These features are: the conidial shape, the presence of black bands, and conidia with a large blackish terminal cell. However, they differ in the number of septa and in the appearance of the conidial wall. In this new species, all the conidia walls are notably verrucose. Another species very similar to *B. palmicola* is *Bactrodesmuim globosum* Hol.-Jech. found on rotten wood of *Fagus sylvatica* from Czechoslovakia (Holubová-Jechová, 1972). The main differences between them are the distinctly verruculose wall in the conidia of *B. palmicola*, the apical cell shape, which is sphaerical in *B. globosum*, in contrast with the obovoid or clavate shape of *B. palmicola*, and the absence of black bands at the conidial septa of *B. globosum*.

Camposporium quercicola Mercado, Heredia et Mena sp. nov.
(Fig. 3)

Coloniae effusae, cinereae vel olivaceae. Mycelium partim superficiale partim in substrato immersum ex hyphis pallide brunneis, septatis, laevibus, 2-3 μm latis. Conidiophora macronemata, recta vel flexuosa, laevia, pallide brunnea, 15-60 x 3.5-4 μm . Cellulae conidiogenae polyblasticae, terminales, cylindricae vel subulatae, denticulatae, 6-10 μm longa et 2-3.5 μm lata. Conidia solitaria, cylindrica, ad apicem rotundata, ad basim conicotruncata, pallide brunnea vel olivacea, cellulis extimis pallidioribus, hyalinis vel subhyalinis, laevia, transversaliter 5-9 septata, 28-45 x 3.5-4.5 μm . Saepe ad apicem 1-3 appendicibus hyalinis vel setulis tenuissimis ad 30 μm longis praedita. Holotypus: 21/IV/1992. G. HEREDIA. CB617 (XAL).

Colonies effuse, grey or olivaceous. **Mycelium** partly superficial, hyphae brown, smooth, 2-3 μm thick. **Conidiophores** macronematous, straight or flexuous, unbranched, smooth, pale brown, 15-60 x 3.5-4 μm . **Conidiogenous cells** integrated, terminal, cylindrical or subulate, denticulate, 6-10 x 2-3.5 μm . **Conidia** solitary, cylindrical, rounded at the apex, conico-truncate at the base, pale brown to olivaceous, the end cells paler than the others, smooth, 5-9 septate, 28-45 x 3.5-4.5 μm , 1-3 non-septate setulae up to 30 μm long. **Habitat:** Cloud forest. On fallen, decaying leaves of *Quercus germana*. Xalapa, Veracruz. **Material examined:** 21/IV/1992. G. HEREDIA. CB617 (XAL).

Discussion. Considering the conidial morphology and the presence of nonseptate setulae, *Camposporium quercicola* is very similar to *C. antennatum* Harkn. (Ellis, 1971) and *C. japonicum* Ichinoe (Matsushima, 1975). The main characteristic that distinguishes these species is the conidial size, *Camposporium quercicola* having smaller and narrower conidia.

Endophragmiella mexicana Mena, Heredia et Mercado sp. nov.
(Fig. 4)

Coloniae effusae, pilosae, atrobrunneae. Mycelium partim superficiale partim in substrato immersum. Conidiophora macronemata solitaria vel 2-3 fasciculata, erecta, simplicia, septata, laevia, brunnea vel atrobrunnea, ad apicem pallidiora, 65-140 x 3-4.8 μm . Cellulae conidiogenae in conidiophoris incorporatae, terminales, percurrentes, 4.5-7.5 longa et 2-3 μm lata. Conidia solitaria, acrogena, ellipsoidea vel obovoidea, transversaliter 2-4 septata, brunnea vel atrobrunnea, saepe cellulis centralibus atrioribus, plerumque cellulis distalibus pallidioribus, 11-16 x 5.8-7.8 μm , ad basem distincte fractam ob partem cellulae conidiogenae superiorem fimbriata. Holotypus: 25/VII/1991. G. HEREDIA CB618 (XAL).

Colonies effuse, hairy, dark brown. **Mycelium** partly superficial, partly immersed. **Conidiophores** macronematous, solitary or arising in groups of 2-3, erect, simple, straight, septate, smooth, brown to dark brown, paler at the apex, 65-140 x 3-4.8 μm . **Conidiogenous cells** integrated, terminal, percurrent, 4.5-7.5 x 2-3 μm . **Conidia** solitary, acrogenous, ellipsoidal or obovoid, thin-walled all around the conidial surface, 2-4 transverse septate, with proximal and distal cells subhyaline or pale brown often with broad black bands at the septa 11-16 x 5.8-7.8 μm with a small frill at the base. **Habitat:** Cloud forest. On fallen, decaying leaves of *Quercus xalapensis*. Xalapa, Veracruz. **Material examined:** 25/VII/1991. G. HEREDIA CB618 (XAL).

Discussion. Based on its conidial morphology, *Endophragmiella mexicana* exhibits affinities with some species of the genus, that were recently described, such as *E. biseptata* (Peck) Hughes, *E. ontariensis* Hughes, *E. fallacia* P. M. Kirk and *E. naromoruensis* P.M. Kirk (Hughes 1979, Kirk 1981, 1985). However, the new species easily can

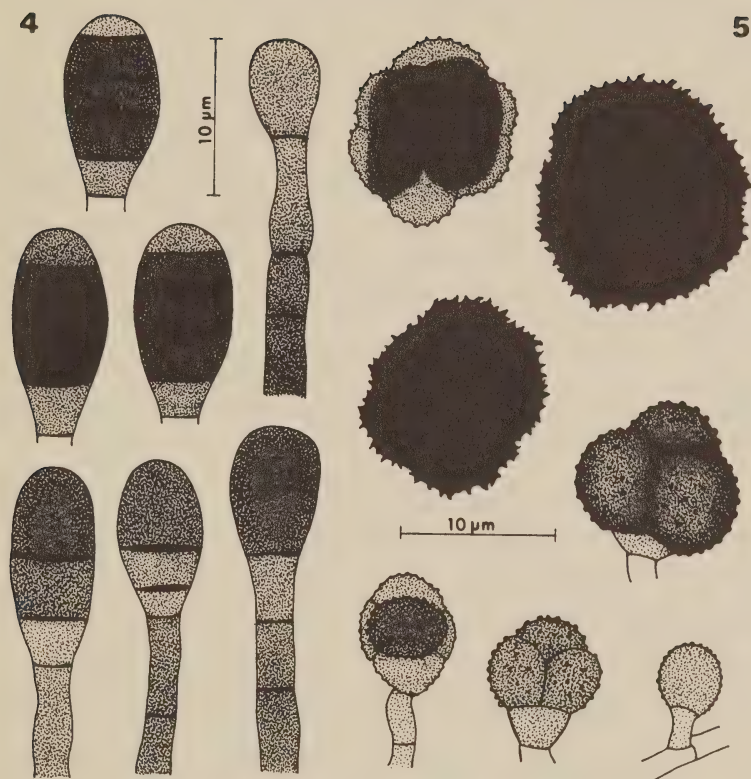


Fig. 4-5. 4. *Endophragmiella mexicana*. Conidiogenous cells, and development of conidia. 5. *Monodictys spinosa*. Conidiogenous cells, developing and mature conidia showing thick and prominent spines.

be distinguished because it has shorter and narrower conidia. A closer affinity can be found with *E. collapsa* (Sutton) Hughes, which has conidial size very similar to *E. mexicana*. However, two features separate the species. In *E. mexicana*, mature conidia are predominantly 4-septate with distal and basal cells paler than the central cells, while in *E. collapsa* conidia are predominantly 2-septate, with the distal cell pale brown to dark brown and the basal cell paler and sometimes collapsed. On the other hand, the conidial wall is thicker in *E. collapsa* than in the new species.

Monodictys spinosa Mercado, Heredia et Mena sp. nov.
(Fig. 5)

Coloniae effusae, atrocinereae vel nigrae. **Mycelium** partim superficiale ex hyphis irregulariter ramosis vel non ramosis, subhyalinis vel pallide brunneis, laevibus, interdum prope cellulam conidiogenam leviter gibberosis, 1.5-3 μm crassis. **Conidiophora** micronemata. **Cellulae conidiogenae** in conidiophoris incorporatae, terminales, determinatae, 2.5-4 μm longa et 1.5-2.5 μm lata. **Conidia** subsphaerica, claviformia, oblonga, utrinque rotundata (ad apicem et basim) vel irregularia, muriformia, atrocinerea vel cinereonigra, atrissima ubi matura, leviter constricta ad septa spinis latis validis; juniora spinis brevioribus vel verrucosa, 10-18 x 8-16 μm . **Cellula basalis** pallidior, 5-6 μm lata. **Conidia matura** crassitunicata, spinis 0.4-1 μm altis. **Holotypus**: 28/VI/1992. G. HEREDIA CB619 (XAL).

Colonies effuse, dark grey to black. **Mycelium** with hyphae subhyaline to pale brown, often swollen near the conidiogenous cell, 1.5-3 μm . **Conidiophores** micronematous. **Conidiogenous cells** integrated, determinate, terminal, 2.5-4 x 1.5-2.5 μm . **Conidia** subspherical, clavate, oblong, rounded at the ends or irregular, muriform, dark grey to black, darker when mature, constricted at the septa, young conidia are verruculose, mature conidia have distinctive, thick and prominent spines, 0.4-1 μm ; conidia size 10-18 x 8-16 μm . **Habitat**: Cloud forest. On fallen, decaying leaves of *Liquidambar macrophylla* Xalapa, Veracruz. **Material examined**: 28/VI/1992. G. HEREDIA CB619 (XAL).

Discussion. The conidial morphology of this species is similar to *Monodictys castaneae* (Wallr.) Hughes. However, the long and thick spines on the mature conidia of *M. spinosa* and their size and color separate it from *M. castaneae*. Two other species that have similar morphological characteristics are *M. fluctuata* (Tandon & Belgrami) M. B. Ellis (Ellis, 1976) and *M. namatacensis* Matsushima. In the latter species, the conidia also have prominent spines but they are sarciniform (Matsushima, 1971). These features, the cellular configuration of the conidia and their size easily distinguish *M. namatacensis* from the new species. We agree with Rao and Hoog (1986) in comprehensive revisions of the genera *Monodictys* and the related genera *Berkleasmius* Zobel and *Pithomyces* Berk. are surely needed.

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A RESTUDY OF PSEUDOGYALECTA VERRUCOSA, ITS SYSTEMATICAL AFFINITIES, AND THE NOMENCLATURAL CONSEQUENCES

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ABSTRACT

A restudy of the morphology and anatomy of the foliicolous lichen *Pseudogyalecta verrucosa* revealed that this species is not related to the Gyalectaceae (Gyalectales), but congeneric with *Badimia* in the Lecanorales, coming closest to *Badimia pallidula*. The nomenclatural consequences are briefly discussed.

INTRODUCTION

The genus *Pseudogyalecta* was introduced by VEZDA (1975) to accomodate a single new species, *P. verrucosa*, characterized by its foliicolous growth habit, verrucose thallus, gyalectoid apothecia with I+ blue hymenium and simple, apically thickened paraphyses, asci with distinct tholus and submuriform ascospores, and Chlorococcaceae as phycobiont. The new genus was considered to be related both to *Gyalecta* Ach. (Gyalectaceae) and *Gyalidea* Lett., the latter at that time included in the Asterothyriaceae, but now referred to a new family Solorinellaceae (VEZDA & POELT 1990). As *Pseudogyalecta* could not be included neither in the Gyalectaceae nor in the Asterothyriaceae without a considerable extension of their respective diagnoses, VEZDA (1975) discussed the erection of a new family.

However, subsequent studies of *Pseudogyalecta verrucosa* by the first author indicated that this species might actually belong to the order Lecanorales, and here to the family Ectolechiaceae, rather than being related to the Gyalectales. This was partly confirmed by a closer investigation of the type material by the second author, who suggested a relationship to certain species of *Badimia* VEZDA (1986), a genus formerly referred to the Ectolechiaceae, but now included in the Pilocarpaceae (LÜCKING et al. 1995).

We therefore conducted a detailed restudy of the morphology and anatomy of *Pseudogyalecta verrucosa*, in order to establish its correct systematical position.

MATERIAL AND METHODS

All known collections of *Pseudogyalecta verrucosa* originate from tropical Africa. The following specimens were restudied in the present paper: TANZANIA: Morogoro province: Uluguru Mts., mossy forest on the NE slope of Bondwa just below the peak, 2020 m alt., leg. T. Pócs et al., 15.02.1971, no. 6403; Uluguru Mts., above Morogoro town, NE ridge of Bondwa peak, 1700-1760 m alt., leg. T. Pócs, 22.02.1972, no. 6538; Uluguru Mts., mossy forest on the NW ridge of Palata, 1700-1850 m alt., leg. T. Pócs, M. Crosby & C. Crosby, 14.12.1972, no. 6851; Ukaguru Mts., mossy forest on the NNE slope of Mnyera, below the western peak, 2010 m alt., leg. T. Pócs, 01.01.1972, no. 6870 (holotype); Ukaguru Mts., Mamiwa Forest Reserve, Mamiwa ridge, elfin woodland, 2200 m alt., leg. Mabblerley, VIII. 1972, no. 1381 (all herb. Vezda).

The morphology and anatomy of the specimens were studied according to LÜCKING et al. (1995), who reinvestigated a large number of species of *Fellhanera* and *Badimia* in order to elucidate their systematical relationships. The following characters were taken into consideration: thallus morphology (micro- and macrostructure, colour), apothecial morphology and external development (size, shape, and colour of primordial stages and mature apothecia), apothecial anatomy (exciple; epithecium; hypothecium; hamathecium; ascus structure; size, shape, and septation of ascospores), anamorph (external appearance and anatomy; size, shape, and septation of conidia), and phycobiont.

RESULTS

Thallus morphology. - The thallus of *Pseudogyalecta verrucosa* is provided with large, hemispherical verrucae which are 0.15-0.2 mm in diameter and filled with colourless crystals, probably calcium oxalate (Fig. 1A-C). Between the verrucae the thallus is smooth to very minutely farinose. The thallus colour varies from whitish or pale greyish to light bluish or greenish grey, the verrucae being purely white or at least paler than the remainder of the thallus.

Apothecial morphology and external development. - The apothecia are regularly rounded, but may become somewhat irregular in outline when old. The apothecial disc is usually plane (Fig. 1A-C). Apothecial ontogeny is gymnocarpous, and early primordial stages are visible as hemispherical papillae (Fig. 1A). The apothecial margin is not very distinct and disappears in old apothecia (Fig. 1B-C). The diameter of mature apothecia varies between 0.3 and 1.0 mm. The apothecial disc is pale flesh-coloured to orange and somewhat translucent, with the margin being concolorous with the disc or slightly paler.

Apothecial anatomy. - The lateral part of the exciple is paraplectenchymatous, its cells having relatively thick, gelatinous walls, whereas the internal part is composed of radiate, branched hyphae embedded in a gelatinous mass (Fig. 2A). There is no encrustation with crystals in any part of the exciple. However, the outermost margin of the exciple sometimes disintegrates into short threads with globose cells (cf. LÜCKING et al. 1995). An epithecium is not distinct. The hypothecium is colourless to pale yellowish.

The paraphyses are usually simple, septate, 1.5-2 μ m thick and slightly thickened apically (Fig. 2B). The ascus is of the lecanoralean type, with a well developed tholus. When stained in Lugol's solution, the ascus tip exhibits a more or less tubular structure becoming broader towards the apex. The upper- and outermost part of the tholus is darker than the central and basal parts (Fig. 2B). This structure matches the *Badimia*-type (LÜCKING et al. 1995), which is most similar to the *Byssoloma*-type sensu HAFELLNER (1984).

The ascospores are 20-32 x 5.5-7 μ m in size, ellipsoid to fusiform and colourless. Most ascospores are 7-septate, but part of the ascospores becomes submuriform when mature, with 1(-2) longitudinal septa. Very rarely ascospores with only (4-)5(-6) or with (8-)9(-10) transverse septa were found (Fig. 2C).

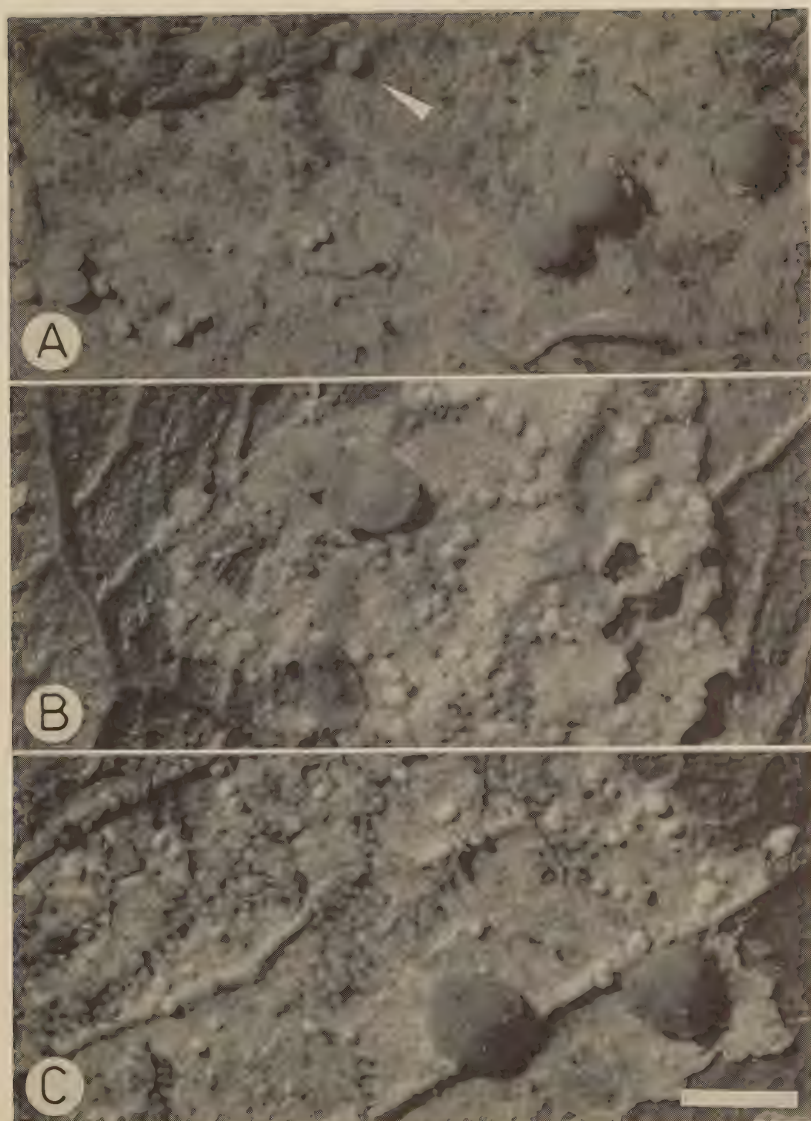


Fig. 1 *Pseudogyalecta verrucosa* (A holotype, B-C T. Föcs et al. no. 6851). (A) Thallus with young (arrow) and mature apothecia. (B)-(C) Thalli with distinct verrucae and mature apothecia. Scale = 1 mm.

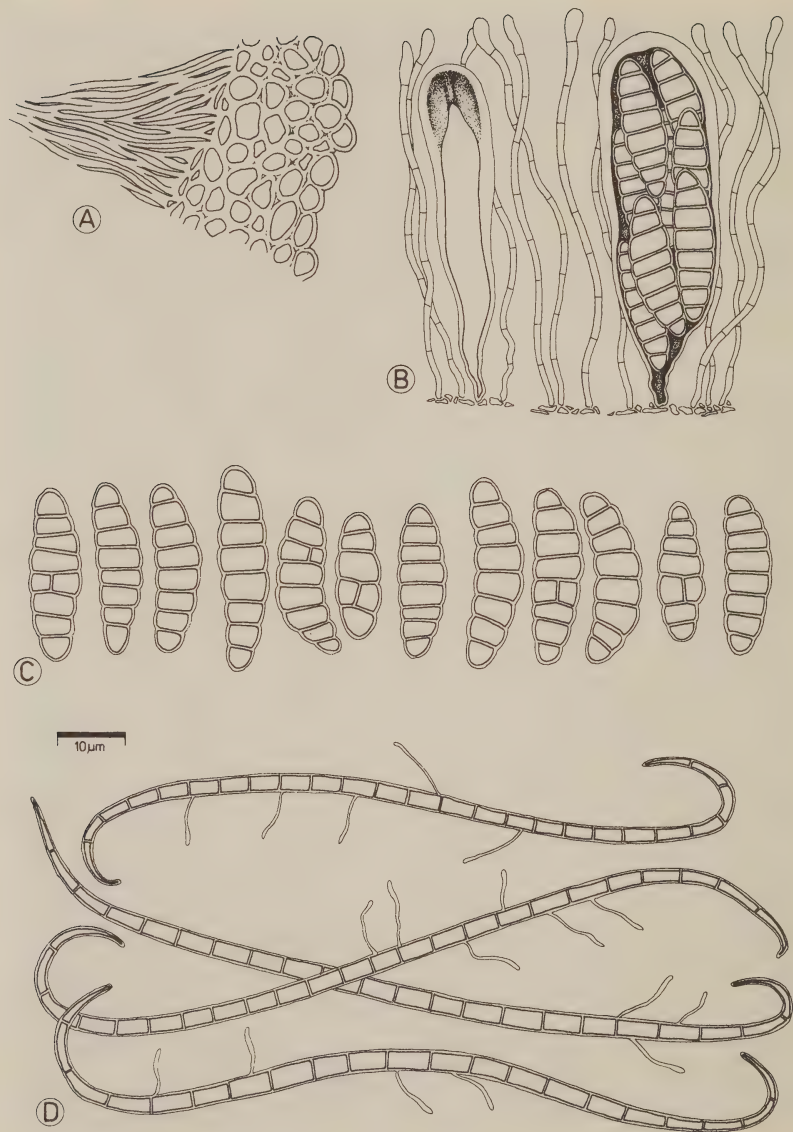


Fig. 2: *Pseudogyalecta verrucosa* (A-C holotype, D Mabberley no. 1381). (A) Section through the lateral part of the exciple. (B) Part of the hamathecium with paraphyses and asci; left ascus showing colour reaction of the tholus when stained in Lugol's solution. (C) Ascospores. (D) Conidia of the campylidia.

Campylidia. - A careful reinvestigation of the available collections other material from different localities revealed two specimens of *Pseudogyalecta verrucosa* carrying campylidia (T. Pócs *et al.*, no. 6403; Mabberley, no. 1381). The campylidia are of the *Badimia*-type and very similar to those described for *B. polillensis* by SÉRUSIAUX (1986). Mature ones are about 0.7-1.5 mm broad and 0.3-0.6 mm deep. Their upper part is pale flesh coloured to orange, similar to the colour of the apothecia.

The conidia are filiform, multiseptate, 100-120 x 2-2.5 µm in size, and provided with several, 8-10 µm long and 0.5 µm thick lateral appendages (Fig. 2D).

Phycobiont. - The phycobiont is a species of Chlorococcaceae, probably belonging to the genus *Trebouxia*. Its cells are rounded and 7-10 µm in diameter.

DISCUSSION

As obvious from the description, *Pseudogyalecta verrucosa* belongs to Lecanorales s.str. and is not related to the Gyalectales. Most of the characters mentioned above were correctly circumscribed in the original diagnosis (VEZDA 1975). However, the apothecial development, the detailed ascus structure, and the campylidia were unknown at that time. The gyalectoid apothecia and the simple, clavate paraphyses make it easily understandable why the species was related to the Gyalectales instead of the Lecanorales.

A comparison of *Pseudogyalecta verrucosa* with representants of the genus *Badimia* (LÜCKING *et al.* 1995) demonstrates that *Pseudogyalecta verrucosa* is closely related to *Badimia pallidula* (KRMPH.) VEZDA and in fact only separated by the larger ascospores with more numerous septa, and by the somewhat different excipular structure. The close relationship is confirmed by the presence of campylidia which both morphologically and anatomically agree with those of *Badimia pallidula* and the closely related *B. polillensis* (VAIN.) VEZDA (SÉRUSIAUX 1986; LÜCKING *et al.* 1995). Actually, a generic distinction between *Pseudogyalecta verrucosa* and these taxa is not possible. On the other hand, *Badimia pallidula* and its relatives, the so-called *B. polillensis*-group (LÜCKING *et al.* 1995), cannot be separated from the generic type, *B. dimidiata* (BABINGT. ex LEIGHT.) VEZDA, although the *B. polillensis*-group exhibits some differences in apothecial morphology and anatomy if compared to the rest of the genus, e.g. the translucent apothecia, the external apothecial development, and the lack of excipular crystals (LÜCKING *et al.* 1995). This means that the generic names *Pseudogyalecta* and *Badimia* are synonymous.

At present, the genus *Badimia* comprises nine species which play an important role in the foliicolous lichen flora in both the neotropical and paleotropical region (LÜCKING *et al.* 1995). Thus, if *Pseudogyalecta* is accepted as the valid name for this genus, this would create a large number of unfortunate nomenclatural changes. Moreover, due to its ascospore septation and lack of excipular crystals, *Pseudogyalecta verrucosa* is not a typical member of *Badimia*, the latter being more appropriately characterized by *B. dimidiata* and its relatives, including the *B. elegans*-group (SÉRUSIAUX 1986; LÜCKING *et al.* 1995). We therefore simultaneously propose the name *Badimia* VEZDA to be conserved against *Pseudogyalecta* VEZDA (LÜCKING & VEZDA 1995).

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A NEW SPECIES OF *DIAPORTHE* ISOLATED FROM STEM WOUNDS OF *EUCALYPTS* IN AUSTRALIA

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SUMMARY

A new species of *Diaporthe* and its new *Phomopsis* anamorph are described as *D. eucalypticola* K. M. Old & Z. Q. Yuan sp. nov. and *P. eucalypticola* K. M. Old & Z. Q. Yuan sp. nov. based on isolations from stem wounds in *Eucalyptus* spp. in Australia. Morphological differences and similarities between the new species and related species of *Diaporthe* and *Phomopsis* are discussed. Pathogenicity tests using both seedling and sapling inoculations indicate that this new species is of low pathogenicity and is an opportunistic wound coloniser and saprophyte.

INTRODUCTION

During a survey of fungi infecting harvesting wounds of residual regrowth forest trees at Cabbage Tree Creek, Victoria, Australia, a coelomycetous fungus was frequently isolated from stem wounds in *Eucalyptus globoidea* Blakely and *E. sieberi* L. Johnson. The fruiting structures of both the anamorph and teleomorph of this fungus were successfully induced by inoculating seedling stems and excised twigs. Morphological examination showed it to be a member of the genus *Diaporthe* Nitschke with a *Phomopsis* anamorph. Because there are no known species in *Diaporthe* to accommodate it we propose the new species as *Diaporthe eucalypticola* and its anamorph as *Phomopsis eucalypticola* sp. nov. The pathogenicity of the fungus was tested.

The type material is deposited in the Herbarium of the Institute for Horticultural Development (VPRI) in Melbourne, Australia and the isotypes in the National Herbarium of Canada in Ottawa (DAOM) and CSIRO, Division of Forestry in Canberra, Australia (DFR).

MATERIALS AND METHODS

The isolates of the fungus examined in this study were associated with stem wounds of *Eucalyptus* spp. The anamorph and teleomorph

were induced artificially *in vitro* and *in vivo*. The fungal isolation, induction of fruiting and pathogenicity test procedures were as follows:

Isolation

Small pieces, about 0.5-1.0 cm square were cut from discoloured sapwood of *Eucalyptus* spp. The wood pieces were washed with sterile distilled water (SDW) and rinsed with 70% ethanol, then surface-sterilised with 5% sodium hypochlorite for 2 min, and finally rinsed with SDW again. They were then plated onto 3% malt agar (MA). The plates were incubated at 17°C in darkness until mycelium appeared (approx. 6 days), then subcultured to potato dextrose agar (PDA) and incubated at 20°C.

Induction of fruiting

Isolates were subcultured onto PDA in plastic Petri dishes. After about 7 days incubation in darkness at 17°C the Petri dishes were sealed with laboratory film and were incubated on a bench, under a diurnal cycle of 12 hours fluorescent light with near-UV component (40W 'True-Lite', from Duro-lite Corp. NJ) and 12 hours darkness, at room temperature until sporulation.

Cultures on sterilised eucalypt twigs were also used to induce sporulation. Twigs about 0.5 cm in diam and 4 cm long cut from healthy eucalypt branches were placed in polycarbonate tissue culture tubes which contained moist cotton wool. The tubes with twigs were autoclaved for 20 min. at 120°C. PDA pieces about 0.5 cm square, taken from one week-old cultures grown in darkness at 20°C were inoculated onto twigs. After incubation in darkness at 20°C for two days the inoculated twigs were exposed to light (as described above) until sporulation was evident.

Pathogenicity tests

Seedling inoculation:

The pathogenicity of this fungus was tested against 1-year-old seedlings of seven of the species that constitute the mixed-species eucalypt stands of the region, namely *E. baxteri* (Benth.) Maiden & Blakely ex J. Black, *E. botryoides* Smith, *E. cypellocarpa* L. Johnson, *E. globoidea*, *E. muelleriana* A. Howitt, *E. obliqua* L'Her. and *E. sieberi*. A stem wound inoculation method (Old & Kobayashi, 1988) was used with five seedlings of each species being inoculated with fungal mycelium growing on a mixture of rice and wheat bran. Each seedling also received a second wound which was inoculated with sterile bran. Trees were harvested after 3 months and stem lesions were measured. For comparison, trees in the same trial were inoculated with the recognised eucalypt canker pathogen, *Endothia gyrosa* (Schw.: Fr.) Fr. (Walker, Old & Murray, 1985).

Sapling inoculation:

Pathogenicity tests were also conducted on 13-year-old *E. sieberi* at Cabbage Tree Creek. Dominant and codominant trees were selected

and 6 replicate trees were inoculated with the *Diaporthe* isolate, and for several other putative pathogens including *E. gyrosa*. Each tree was wounded to the depth of the sapwood using a surface sterilised 5 mm diam increment borer at three equidistant points around the stem circumference and two wounds were inoculated with fungi, the remaining wound being treated with sterile bran. After 6 months the extent of bark necrosis was measured and the stems of the standing trees were dissected with chisels to ascertain the extent of sapwood discolouration. Sapwood samples were taken for reisolation of the inoculated fungi.

RESULTS AND DISCUSSION

Morphological description

Diaporthe eucalypticola K.M. Old & Z.Q. Yuan **sp. nov.** Fig. 1a-g

Ascomata discreta, laxe immersa in pseudostromate marginali nigrofusco, sphaerica ad sphaeroidea, 200-300 µm lata, 160-250 µm alta, collis 250-500 µm altis, basi 80-100 µm et apice 30-40 µm diam. Peridium 14-32 µm crassum, cellulis compressis, brunneis compositum. Asci 30-50 x 7-9 µm, clavati, apice truncati, octospori, cum annulis apicalibus distinguendis, refractis, inamyloideis. Ascospores 10-14 x 2-4 µm, superimpositae biseriatae vel raro oblique uniseriatae, hyalinae, elongati-ellipsoideae ad cylindricae, extremis obtusis vel raro acutulis, inequilaterales vel rectae, 1-septatae, ad septum non constrictae, septo medio, cum appendicibus 2-3 µm longis, setaceis, delicatis in quoque extremo ascosporae, 4-guttulatae.

Holotypus in ramulis artificiose inoculatis *Eucalypti* sp. ex culturis asexii (ORB1), CSIRO, Division of Forestry, Canberra, Australia, V. 1991, K.M. Old et al. VPRI 20391, isotypi: DAOM, DFR 203.

Anamorph: *Phomopsis eucalypticola* K.M. Old & Z.Q. Yuan **sp. nov.**

Fig. 1h-m

Conidiomata eustromatica ad pycnidica, discreta, immersa, unilocularia, irregulariter sphaerica ad sphaeroidea, 200-400 µm lata, 120-200 µm alta, ex cellulis compressis, brunneis, crassitunicatis composita. Conidiophora hyalina, septata, ramosa, (6-) 12-20 x 2-3 µm. Cellulae conidiogenae hyalinae, cylindricae, enteroblasticae, phialidicae, integratae. Conidia bigeneria: α-conidia hyalina, unicellularia, ellipsoidea vel interdum obovoidea, 2-guttulata, 5-7.5 x 2.0-3.0 µm; β-conidia hyalina, unicellularia, filiformia, recta, curvata vel hamata, 10-14 x 1-1.4 µm.

Holotypus ex ascospora solitaria *Diaporthis eucalypticolis* K.M. Old et Z.Q. Yuan, in cultura sicca in agar depositi, VPRI 20403, isotypus: DFR 238 (= culture ORB67).

Ascomata separate, immersed beneath a narrow blackened dorsal area in the periderm and loosely arranged above a blackened marginal zone deep in the wood, globose or depressed, 200-300 µm wide and 160-

250 µm high; beak protruding through bark, 250-500 µm high and 80-100 µm diam at base, 30-40 µm diam at apex, however beaks on inoculated twigs in tubes very long, up to 2.5 mm in length and 0.15 mm in width. Peridium 14-32 µm wide, of several layers of compressed cells. Asci 30-50 x 7-9 µm, clavate with apex more or less truncate, with nonamyloid refractive apical rings, 8-spored. Ascospores 10-14 x 2-4 µm (mean = 11.5 x 3.6 µm, n = 100), overlapping biseriate or seldom obliquely uniseriate in the ascus, hyaline, elongated-ellipsoid to cylindrical, rounded ends or sometimes tapering, inequilateral or straight, with 1 median septum, not constricted at the septum, often bearing delicate setose appendages at each end, 2-3 µm long; 4-guttulate.

Conidiomata eustromatic to pycnidial, separate, immersed in tissue, irregularly globose or depressed, unilocular, 200-400 µm wide, 120-200 µm high, wall of several layers of thin-walled, brownish to brown, elongated cells. Conidiophores hyaline, branched, septate, (6-) 12-20 x 2-3 µm. Conidiogenous cells enteroblastic, phialidic, integrated, cylindrical. Conidia of two types: alpha conidia (α-conidia) hyaline, one-celled, ellipsoid, sometimes obovoid, 2-guttulate, 5-7.5 x 2.0-3.0 µm (mean = 6.4 x 2.5 µm, n = 100); beta conidia (β-conidia) hyaline, one-celled, filiform, straight, curved or hamate, 10-14 x 1-1.4 µm (mean = 11.9 x 1.1 µm, n = 100).

Isolated from stem wounds of *Eucalyptus globoidea* and *E. sieberi*.

Specimens and cultures examined:

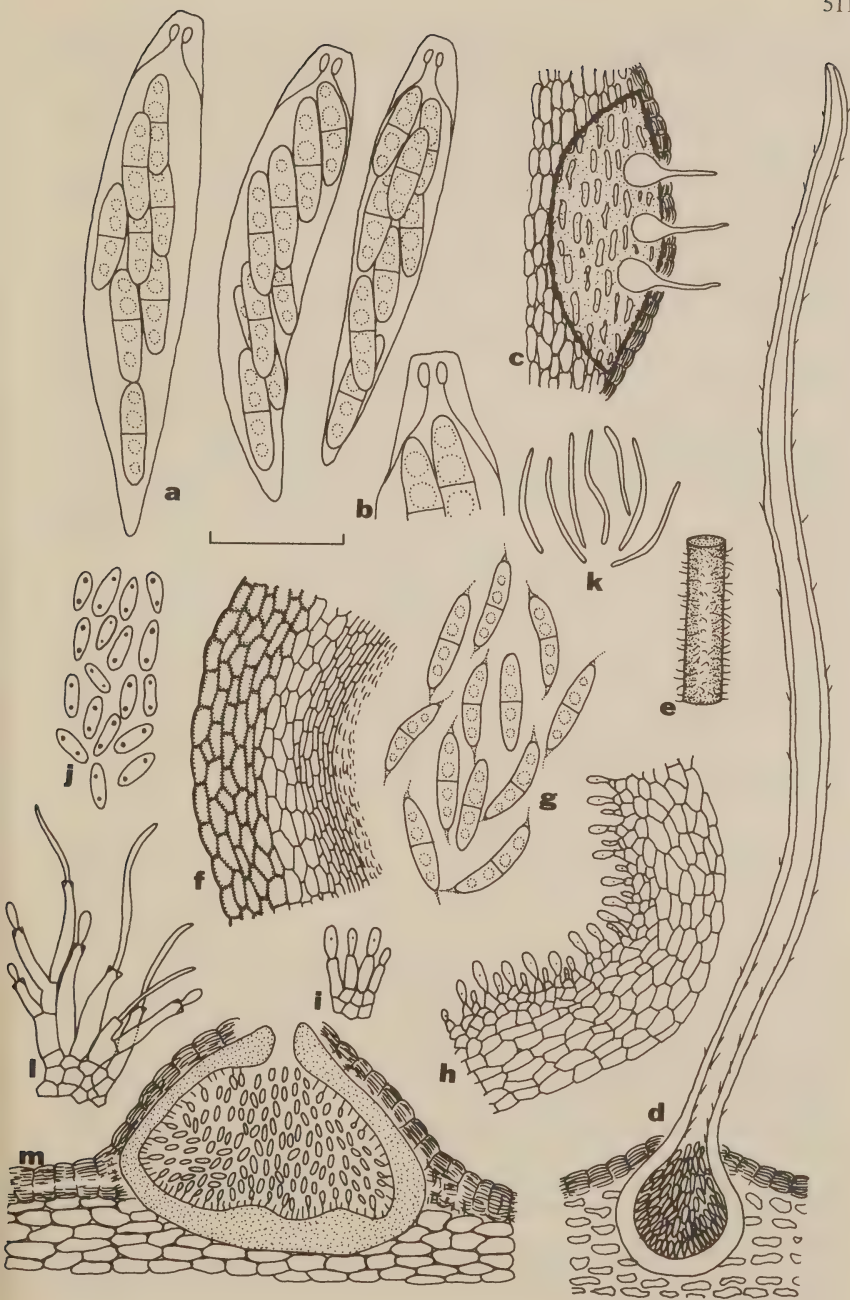
(i) Specimen on autoclaved excised twigs of *Eucalyptus* sp. by inoculating asexual culture ORB1, CSIRO, Div. of Forestry, Canberra, Australia, V. 1991. K.M. Old, VPRI 20391 (holotype of the teleomorph), isotype: DAOM & DFR 203.

(ii) Culture from a single ascospore of the teleomorph on specimen DFR 203, CSIRO, Div. of Forestry, Canberra, Australia, X. 1989. M.J. Dudzinski, VPRI 20403 (holotype of the anamorph), isotype: DFR 238 (= culture ORB67).

(iii) Culture from stem wounds of *E. globoidea*, Cabbage Tree Creek, Victoria, Australia, 28. IV. 1989, K.M. Old *et al.*, ORB1.

(iv) Cultures from stem wounds of *E. sieberi*, Cabbage Tree Creek, Victoria, Australia, IV. 1989, K.M. Old *et al.*, ORB11; 30 X. 1989, K.M. Old *et al.*, VPRI 20402, isospecimen: DFR 239 (= culture ORB86); III. 1994, M. J. Dudzinski, ORB752.

Fig. 1. a-g: *Diaporthe eucalypticola*, a. asci, b. ascus apex, c. ascoma in vertical section (on inoculated seedlings in shade house, VPRI 20393), d. ascoma in vertical section with long neck (on inoculated twigs in tubes, holotype), e. habit on twigs, f. detail of peridium, g. ascospores; h-m: *Phomopsis eucalypticola*, h. detail of conidiomatal wall, i. conidiophores (from the conidiomata on seedlings, VPRI 20393), j. α-conidia, k. β-conidia, l. conidiophores (from the conidiomata on PDA medium, holotype), m. conidioma in vertical section. (Standard bar = 12 µm for a & b, = 1 mm for c, = 240 µm for d, = 24 µm for f, h, i, = 20 µm for g, j, k, l and = 150 µm for m; e about natural size)



(v) Specimen on seedling of *E. globoidea*, by inoculating asexual culture ORB404, CSIRO, Div. of Forestry, Canberra, Australia, V. 1991. K.M. Old *et al.*, VPRI 20393, isospecimens: DAOM & DFR 96.

(vi) Specimen on inoculated autoclaved excised twigs of *Eucalyptus* sp. CSIRO, Div. of Forestry, Canberra, Australia, I. 1991. K.M. Old, VPRI 20392, isospecimens: DAOM & DFR 202.

(vii) Specimen on sapling of *E. sieberi*, Cabbage Tree Creek, Victoria, Australia, III. 1990, K.M. Old *et al.*, DFR 85 & 86.

Average radial growth rate of colonies on PDA at 20°C in darkness approximately 7.5 mm per day; colonies initially are white, velvety, with a characteristic fine swirling growth pattern during the first few days of growth after inoculation. Colonies become buff and cottony or floccose with mycelium raised in two or three concentric irregular circles about the colony centre and turn grey under exposure to fluorescent lights; reverse yellow brownish, yellow brown or dark amber-coloured, sometimes with brown to black blotches. After 7-10 day's exposure of the culture under lights, fruit bodies started to form on agar separately or in groups of 3-5. All cultures produced abundant conidiomata under the above conditions. However, only two, ORB67 and ORB86, produced both α -conidia and β -conidia.

No teleomorph was produced on PDA for any culture in darkness or under fluorescent light with a near-UV component. However, old colonies in darkness formed sparsely occurring globules, often on Petri dish wall, with dark brown exudate. These might be possible ascostromatal initials of the fungus. As the culture ORB67 was derived from a single ascospore of the teleomorph (DFR 203) which was produced by inoculating the isolate ORB1 onto autoclaved excised twigs of *Eucalyptus* sp, there is no doubt of the linkage of the anamorph and the teleomorph.

The anamorph of the present species was isolated frequently from stem wounds on living trees and the teleomorph was produced by inoculating the anamorph onto living seedlings and onto autoclaved twigs. The features of the teleomorph from both inoculations are consistent, except for the beaks of the ascomata which extended much more strongly under the conditions of the twig inoculations.

Species of *Diaporthe* and *Phomopsis* have been described on *Eucalyptus* spp. *D. eucalypti* Harkn., described from leaves of *Eucalyptus globulus* in California, USA (Saccardo, 1886) is regarded as a synonym of the collective species *D. medusaea* Nitschke according to Wehmeyer (1933). This species has been known from numerous host plants (Kobayashi, 1970; Wehmeyer, 1933). The present *Diaporthe* fungus isolated from stem wounds of *Eucalyptus* spp. is closely similar to *D. medusaea* or *D. eucalypti* in the formation of elongated beaks and the size of ascospores. However, they differ from each other in some other characteristics:

The ascomata of this new species are loosely or separately arranged above a blackened marginal zone deep in the wood, mostly

shallowly immersed under the periderm with the majority of the neck extending outside the plant tissue, while those in *D. medusaea* are deeply immersed and the necks collectively erumpent through the peridermal layers (Kobayashi, 1970).

The new species has elongated-ellipsoid to somewhat cylindrical ascospores and mostly inequilateral (slightly allantoid) with both ends rounded, rather than ellipsoid-fusoid tapering at ends and straight as in *D. medusaea* (Kobayashi, 1970; Wehmeyer, 1933).

Although ascospores with short, narrow appendages have been previously recorded in some species of the genus *Diaporthe* (Barr, 1978; Kobayashi, 1970; Wehmeyer, 1933), no indication of such appendages has been recorded on ascospores of *D. medusaea* or *D. eucalypti* (Harkness, 1884; Kobayashi, 1970; Wehmeyer, 1933). The ascospores of this new species, however, often bear one, 2-3 μm long, delicate setose appendage at each end.

Phomopsis rudis (Fr.) Hoehn., the anamorph of *D. medusaea*, has much longer β -conidia than those of the new species. The β -conidia of *P. rudis* measure 17-30 x 0.5-1 μm (mean 24.6 x 0.9 μm) (Kobayashi, 1970) or 21-30 x 1.5 μm (Nitschke, 1870), while ours are 10-14 x 1-1.4 μm (mean 11.9 x 1.1 μm) in size.

Phomopsis eucalypti Zerova (Bot. Zurn. 1: 307, 1940), described from living and dead twigs of *Eucalyptus* sp in a greenhouse in the former USSR has been recorded causing severe leaf spot disease of seedlings of several *Eucalyptus* species in India (Mohanani & Sharma, 1987). However this *Phomopsis* species has larger β -conidia than the proposed new species measuring 20-25 x 1.5-1.8 μm (Uecker, 1988) or 15.4-25 μm long (Mohanani & Sharma, 1987).

The occurrence of necks on some conidiomata of this new species was observed on inoculated twigs and in culture on PDA (ORB752). This is unusual and might be a characteristic in *Phomopsis*.

Although *D. medusaea* has not been reported on eucalypts within Australia, we believe that the proposed new species is a different but closely related and undescribed species.

Pathogenicity to seedlings and saplings

Although the *Diaporthe* species induced bark necrosis and was readily isolated from inoculated seedlings after 3 months, stem lesions were small, mean increase over controls for the seven eucalypt species varying from 7 mm in *E. obliqua* to 22 mm in *E. cytellocarpa*, and many lesions had healed. In contrast an isolate of *E. gyrosa* had induced necrotic lesions considerably longer than these (94 mm in *E. cytellocarpa*, the most susceptible species) and girdling was almost complete in some instances.

Saplings inoculated in the field with *Diaporthe* were little affected, with bark lesions not significantly different in length from controls (30 mm). External lesions caused by *E. gyrosa* were 40-50 mm in length, the main difference between the fungi being in sapwood discolouration which was 30 mm on average for *Diaporthe* and 70-110

mm for two isolates of *E. gyrosa*. The restriction of *Diaporthe* to sapwood close to the point of inoculation was consistent with its recovery from naturally infected wounds. Although the fungus could be isolated from wounds two years after sapwood exposure, it was never found at the extending margin of discoloured sapwood within the stem, distal to the wound. In contrast, after 12 months, *E. gyrosa* was isolated from this niche in 50% of all dissected stems.

It must be concluded that the *Diaporthe* isolates studied here are weak pathogens or saprophytes which appear to be opportunistic wound colonisers.

ACKNOWLEDGMENTS

We are much obliged to Dr. M.E. Barr (Sidney, Canada) for advice on the disposition of the new species and for reviewing the manuscript. The kind collaboration of the Department of Conservation and Natural Resources, Victoria which enabled access to State Forest at Cabbage Tree Creek, for fungal isolation and inoculations, is much appreciated. We are also grateful to R.J. Gibbs for her technical assistance. Part of this work was undertaken during the tenure by the senior author of an overseas study grant from the State Education Commission of P.R. China and with financial support of the Australian Tree Seed Centre, CSIRO Division of Forestry.

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STUDIES IN TROPICAL AFRICAN *LACTARIUS* SPECIES. 1. *LACTARIUS GYMNOCARPUS* R. HEIM EX SINGER AND ALLIED SPECIES.

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1. ABSTRACT

Lactarius gymnocarpus R. Heim ex Singer, first described from Guinea, Cameroon and Ivory Coast, later validly described from Liberia, is very different from the "*L. gymnocarpus*" which HEIM described afterwards from Zaire. Examination of 99 collections, mainly from African miombo woodland, revealed six new species, all allied to *Lactarius gymnocarpus*: *L. pseudogymnocarpus*, *L. longisporus*, *L. gymnocarpoides*, *L. luteopus*, *L. medusae* and *L. flammans*. A key to the species is given.

2. INTRODUCTION

Lactarius gymnocarpus was invalidly described by HEIM in 1943, from the rainforest of West Africa (Ivory Coast, Cameroon and Guinea). Three of the cited specimens are conserved in the National Museum of Natural History of Paris (PC). No type-specimen was indicated. SINGER provided a Latin diagnosis in 1946 based on a specimen from Liberia. In 1955 HEIM redescribes *L. gymnocarpus* in a revision of *Lactarius* for the "Flore Iconographique des Champignons du Congo". He gave a superfluous Latin diagnosis and completed his earlier description (1943) with data from the collections of Mme GOOSSENS-FONTANA from Zaire.

A detailed study of the available material revealed that there are different species belonging to a complex group. The original specimens from HEIM and the specimen from SINGER represent the same species. The

specimens from Zaire, which HEIM cited in 1955, clearly represent another species.

3. MATERIAL AND METHODS

This study was based on herbarium material from the National Botanic Garden of Belgium (BR), the Royal Botanic Garden of Edinburgh (E), the Farlow Herbarium of the Harvard University (FH), Universiteit Gent (GENT), the University of Helsinki (H), the Royal Botanic Gardens of Kew (K), the National Museum of Natural History of Paris (PC) and the personal herbaria of Bart Buyck (BUYCK) and Daniel Thoen (THOEN). An important part of the macroscopical features is based on field notes of my own collections from Burundi (deposited at BR and GENT).

Microscopic features are studied in congo red in NH_4OH or L_4 (CLEMENÇON, 1972) (eventually after a short passage in KOH 10% solution). Spore ornamentation is described and illustrated as it appears in Melzer's reagent. Line drawings are made with the aid of a drawing tube at magnifications 6700x for spores, 3200x for individual elements and 1100x for sections and surface views. Stippling indicates refractive contents in cystidia and lactifers.

Spores are measured in side view, excluding the ornamentation and measures are given as (MINa) $[\text{AVa} - 2 \cdot \text{SD}] - \text{AVa} - \text{AVb} - [\text{AVb} + 2 \cdot \text{SD}]$ (MAXb) in which AVa = lowest mean value for the measured collections, AVb = greatest mean value and SD = standard deviation. Q stands for "quotient length/width" and is given as (MINQa) $Qa - Qb$ (MAXQb) in which Qa, resp. Qb, stand for the lowest, resp. the highest, mean quotient for the measured specimens.

Colour codes are from KORNERUP & WANSCHER (1978). L+I/cm means number of lamellae (L) and number of lamellulae (I) per cm at pileus mid-radius. Names of phytogeographical regions and vegetation types are according to WHITE (1983).

4. RESULTS

The *Lactarius gymnocarpus*-complex is characterised by mainly vividly coloured (orange-like) species with thick and distant, decurrent lamellae. The spores have a very low ornamentation, mostly forming an incomplete reticulum, although isolated warts can be distinct. The pileus is mostly amyloid. The suprapellis of the pilei- and stipitipellis is composed of

thick-walled, usually hairshaped elements; the subpellis is pseudoparenchymatous. The trama of the lamellae is heteromerous.

Six new species are described in the *Lactarius gymnocarpus*-complex. The most important characters to distinguish the species are the colours of stipe, pileus and lamellae, the shape, the dimensions (Fig. 1) and the ornamentation of the spores, the presence and abundance of macropleurocystidia and the shape and size of the elements in pilei- and stipitipellis. Because of the lack of complete data on some specimens, some additional undescribed species are included in the key to focus attention on their existence.

In 1928 BEELI described *L. goossensiae* without indicating a type-specimen. A re-examination of the three cited collections revealed that GOOSSENS-FONTANA 547 and GOOSSENS-FONTANA 213 are *Lactarius gymnocarpus* sensu stricto; GOOSSENS-FONTANA 268 represents a different species. *L. goossensiae* has, therefore, to be considered a nomen dubium.

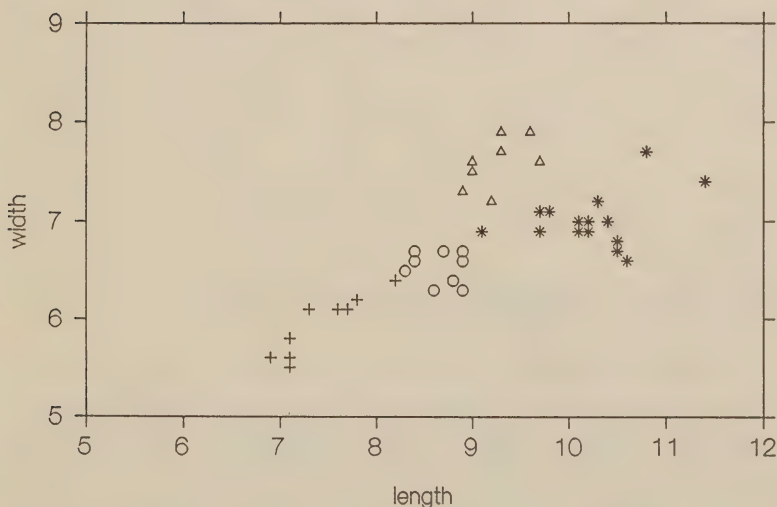


FIG. 1. Mean spore measurements (in μm , 20 spores measured/collection) of collections of *Lactarius gymnocarpus* (+), *L. luteopus* (o), *L. gymnocarpoides* (Δ) and *L. longisporus* (*).



FIG. 2. Geographical distribution of tropical African *Lactarius* species.
 collection sites of studied specimens ▨
Lactarius gymnocarpus ●
Lactarius longisporus ▲

Available data suggest that some of the species have a restricted distribution, probably correlated with the distributional pattern of their ectomycorrhizal host: *L. gymnocarpus* seems to be restricted to the Guineo-Congolian Region (rain forest), in contrast with *L. longisporus* and *L. luteopus* which until now have only been found in the miombo woodland of the Zambezian Region. Those data are represented in a distribution map based on the collections of *L. longisporus*, *L. luteopus* and *L. gymnocarpus* (Fig. 2).

5. KEY TO THE SPECIES

1. Macropleurocystidia abundant and emergent, often thick-walled . . . 2
Macropleurocystidia either absent or inconspicuous and scarce . . . 5
2. Pileus conspicuously whitish pruinose; elements of the pileipellis extremely elongate, up to 300 μm long **Lactarius medusae**
Pileus not whitish pruinose; elements of the pileipellis up to 100 μm long. 3
3. Stipe white; spores elongate (average $Q = 1.33\text{-}1.60$)
. **L. longisporus**
Stipe pale orange to pale yellow; spores ellipsoid (average $Q = 1.17\text{-}1.29$) 4
4. Lamella-edge fertile; ornamentation of the spores composed of an incomplete reticulum without distinct warts. . . **L. gymnocarpoides**
Lamella-edge sterile; ornamentation of the spores composed of a partial reticulum and some isolated warts. **L. pseudogymnocarpus**
5. Suprapellis of the pileipellis composed of spherical to cylindric, often irregularly shaped elements, 5-15 μm wide, often branching, very thick-walled; lamellae staining brown 6
Suprapellis of the pileipellis composed of regularly cylindric, narrow elements, less than 10 μm wide; lamella not browning 7
6. Elements from the suprapellis of the pileipellis often 15 μm broad; lamellae very spaced, 2-5 L+l/cm; stipe yellowish orange to golden yellow **L. gymnocarpus**
Elements from the suprapellis of the pileipellis up to 10 μm broad; lamellae slightly denser, 5-8 L+l/cm; stipe white **L. sp. 2**
7. Stipe yellow to greenish yellow (2A4-6 to 1A78), at least at the base; young lamellae concolorous with the stipe; macropleurocystidia present but very scarce, often septate and not emergent **L. luteopus**
Stipe and lamellae never bright yellow; macropleurocystidia absent 8
8. Spores ellipsoid, 7.3-8.4 x 5.5-6.0; average $Q = 1.20\text{-}1.50$
. **L. flammans**
Spores elongate, 8.2-10.3 x 5.2-6.3; average $Q = 1.40\text{-}1.75$. **L. sp. 1**

6. DESCRIPTION OF THE SPECIES

6.1. *Lactarius gymnocarpus* R. HEIM EX SINGER, Pap. Michigan Acad. Sci. 32: 107 (1946). — Fig. 3.

Lactarius gymnocarpus R. HEIM, Boissiera 7: 273 (1943), invalid.

Lactarius gymnocarpus R. HEIM EX R. HEIM p.p., Bull. Jard. Bot. Etat 25: 24 (1955).

Lactarius goossensiae BEELI p.p., Bull. Soc. Roy. Bot. Belgique 60: 165 (1928).

Pileus 6.5-8(15) cm diam., quite thick, first planoconvex then planoconcave to slightly depressed and depressed; margin crenulate; pellis not dehiscent, dry, finely tomentose, with small and sometimes anastomosing veins, yellowish orange to golden yellow (5B7-4A7), ochraceous when older (5C7-5D7). *Stipe* 4-4.5 x 0.6-1.4 cm, cylindric, slightly tapering downwards, dry, finely tomentose, with longitudinal veins on top, concolorous, paler on top when young, darker when old, white tomentum at the base, solid and soon fistulous. *Lamellae* decurrent and extending in longitudinal veins on the stipe, unequal with lamellulae of different lengths, distant (4/cm), medium broad (4-6 mm), thick, yellowish white to pale yellow (3A3), sometimes staining brown; edge concolorous. *Context* firm, brittle, white, irregularly browning; taste mild to sweet; smell slightly unpleasant (*Valeriana*-like). *Latex* quite abundant, watery to waxy, white, unchanging, mild, ochraceous brown on drying. *Spore deposit* white.

Anilated H₂O, *Phenolaniline*: lamellae very slowly reddening, context nihil. *FeSO₄*: context in pileus intense blue-green, context in stipe darker (almost black). *I₂*, *TL4*: nihil. *NaOH*: lamellae intense ochraceous, context nihil. *NH₄OH*: context immediately yellow with olive-shade. *Phenol* 2%: context greyish brown.

Spores ellipsoid, 6.3-7.1-8.2-8.7 x 5.3-5.9-6.4-7.3 µm (*Q* = 1.14-1.21-1.29-1.42; *n* = 100); ornamentation amyloid, composed of irregular warts and fine connective lines, never forming a reticulum; some warts isolated, up to 0.5 µm high; plage sometimes amyloid in the centre. *Basidia* 45-55(75) x 7-9 µm, cylindric to slightly clavate, 4-spored. *Macropleurocystidia* absent. *Pseudopleurocystidia* very numerous, emergent and distinct, 3-5(7) µm diam., cylindric, tapering upwards, sometimes constricted; content oleiferic with granules. *Lamella-edge* sterile; cheilocystidia 35-60 x 4-6 µm, cylindric, slightly clavate or tapering upwards, often septate; wall thickened up to 0.5 µm. *Lamella-trama* composed of sphaerocytes; lactiferous hyphae present. *Pileipellis* two-layered; elements of the suprapellis 20-100 x 5-15 µm, very

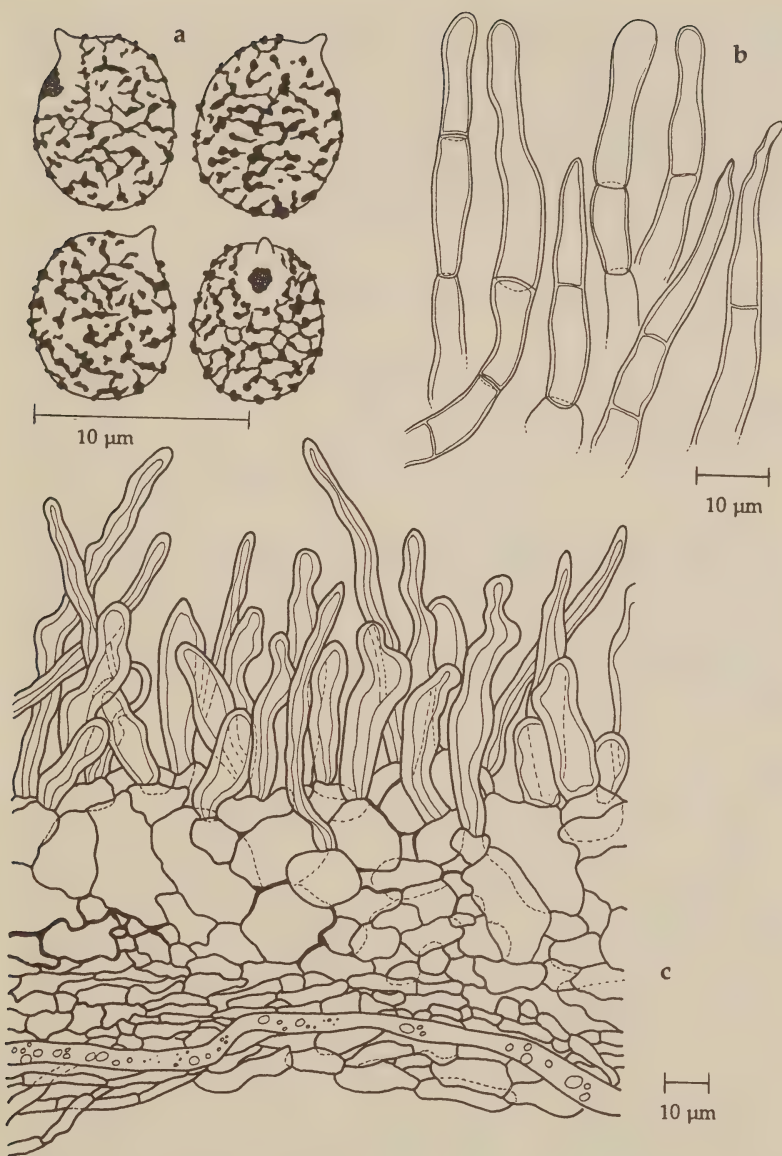


FIG. 3. *Lactarius gymnocarpus* a. Spores (GOOSSENS-FONTANA 547); b. Cheilocystidia (THOEN 7646); c. Section through the pileipellis halfway the pileus radius (THOEN 7646).

irregularly shaped, varying from narrow cylindric to broadly fusiform or almost rounded, often tortuous, with thickened wall (1-3 μm); subpellis cellular, spherical cells (10)15-30 μm , with slightly thickened wall. *Stipitipellis* two-layered; elements of the suprapellis 30-120 x 10-25 μm , very irregularly shaped, often branching, thick-walled (3-5 μm); subpellis pseudoparenchymatous; spherical cells 10-25 μm diam., with slightly thickened wall (1 μm). *Clamp-connections* absent.

ETHNOMYCOLOGICAL NOTES: eaten by the local populations of Kivu, Zaire (RAMMELOO Z 286), Cameroon (HEIM, 1955).

VERNACULAR NAMES: Nchimu (Kirega dialect, Zaire); Jembele, Nsesenge (Eala, Zaire); Quaifaigi (Toma, Guinea); Bandara (Baya, Cameroon).

HABITAT: rain forest, dry coastal forest, swamp forest.

DISTRIBUTION: restricted to the Guineo-Congolian phytogeographical region (Fig. 2).

Cameroon.— *Rain forest*: Korup National Park, near Mundema, S.W. Prov., 01-1989, WATLING 21470, 21475 (E); *ibid.*, 03-1991, WATLING 24154; forest near Amugreta, Ebolowa, 04-1946, HEIM Q43 (PC).

Guinea.— *Dry coastal forest* with *Uapaca*: Saala waterfalls, Fouta Djallon, north of Labbé, 07-1988, THOEN 7894 (THOEN). *Rain forest*: forest of Upper Guinea, 04-1939, HEIM s.n.1 (PC).

Ivory Coast.— *Dry coastal forest*: Tiapleu, Tonkoui, West Prov., 04-1934, HEIM B30 (PC).

Liberia.— Near Nengbe, 04-1939, G.W. HARLEY 56 (lectotypus, FH).

Senegal.— *Rain forest*: National Park of Basse Casamance, 08-1986, THOEN 7605, 7646 et icon. phot. (THOEN, BR); *ibid.*, 09-1986, THOEN s.n.2 (THOEN); *ibid.*, 09-1987, THOEN 7881 (THOEN); *ibid.*, 07-1988, THOEN 7996 (THOEN).

Zaire.— *Swamp forest*: Eala, Equateur Prov., 06.1923, GOOSSENS-FONTANA 213; *ibid.* 01.1926, GOOSSENS-FONTANA 547 (BR). *Rain forest*: Irangi, Kivu Prov., 04-1972, RAMMELOO Z 286 et icon. phot. (GENT).

OBSERVATIONS

1. The macroscopical description is based on RAMMELOO Z 286 and THOEN 7605, 7646 and completed with the descriptions of HEIM (1943) and SINGER (1946); macrochemical characters are from RAMMELOO Z 286. The

microscopical description is based on THOEN 7894, 7605, 7646, WATLING 24154 and HEIM s.n.1, B30, Q43.

2. HEIM first used the name *Lactarius gymnocarpus* (1943) for specimens from Cameroun and Ivory Coast. By the absence of a latin diagnosis, this name was invalid. SINGER described "*Lactarius gymnocarpus* Heim" (1946) with a latin diagnosis based on a specimen from Liberia. He did not indicate the specimen as the type-specimen, but mentioned that HEIM should choose a type-specimen.

I propose the name *Lactarius gymnocarpus* R. Heim ex Singer and G.W. HARLEY 56 as the lectotype.

3. One of the two collections, BEELI (1928) designated for the description of *Lactarius goossensiae*, represents *Lactarius gymnocarpus* (GOOSSENS-FONTANA 213). *L. goossensiae* has to be regarded as a *nomen dubium*, as already noted by HEIM (1955b).

4. The name *Lactarius gymnocarpus* is cited by several authors: HEIM (1955) (= *Lactarius pseudogymnocarpus*); NZIGIDAHERA (1993) (BUYCK 4380 = *Lactarius gymnocarpoides*); PEGLER (1977) (= *Lactarius pseudogymnocarpus*); PEGLER & PEARCE (1980), PEARCE (1981) (= *Lactarius* sp.). Citations of *L. gymnocarpus* by PEGLER in MORRIS (1984, 1987, 1990) and MAGHEMBE & REDHEAD (1980) (in a pine plantation in Tanzania) are considered as very doubtful.

5. The ectomycorrhizal relationship with *Uapaca guineensis* was fully established by THOEN & BA (1989: 555, fig. 4b). The same authors consider *Azzeria africana* as a possible host tree. *Anthonota crassifolia* is listed as putative host tree in THOEN & DUCOUSSO (1989).

6. Coloured illustrations of *L. gymnocarpus* are provided by HEIM (1955b: pl. 2, fig. 1b) and THOEN & BA (1989: pl. 1, fig. 2e).

6.2. *Lactarius pseudogymnocarpus* nov. sp. - Fig. 4.

Lactarius gymnocarpus R. HEIM ex R. HEIM p.p. non typ. quoad descr., icon. et specim. GOOSSENS-FONTANA 809 et 3001 cit. in Bull. Jard. Bot. Etat 25: 24 (1955).

Lactarius gymnocarpus R. HEIM ex R. HEIM auct. non typ., Fl. Iconogr. Champignons Congo 4: 87 (1955).

Misappl. — *Lactarius gymnocarpus* sensu PEGLER (1977).

Pileus 8-14 cm diam., planoconvexus et depressus ad infundibuliformis, inaequaliter lobatus, margine striato; pileipellis aurantio-flava ad fusco-aurantia. *Stipes* 4.5-10 cm longus, 1-2 cm crassus, cylindratus, basin versus attenuatus, subtile rugosus, albus ad aurantio-flavus. *Lamellae* decurrentes, distantes, albo-cremeae demum maculis brunneis. *Latex* non abundans, albus, gustu mitis. *Sporae* albae in cumulo, (7.1)7.7-8.4-9.1-9.9 x 6.0-6.7-7.0-7.6 μm , ellipsoideae, verrucoso-reticulatae. *Macropleurocystidia* abundantia, 50-80(100) x 5-7 μm . *Pileipellis* bistrata; elementa suprapellis 20-60 x 5-10 μm , cylindrata, obtusa ad angustata, pariete incrassato (1-2 μm); subpellis pseudoparenchymata.

Pileus 8-14 cm diam., planoconvex and depressed to infundibuliform; margin crenulate and irregularly lobed when older, striate to grooved (up to 1/3 of the radius), with very fine veins between the grooves; pellis not dehiscent, dry, finely tomentose, with a fine reticulum of gelatinous, sinuous veins, yellowish orange, bright orange to apricot, almost carrot red becoming brownish orange. *Stipe* 4.5-10 x 1-2 cm, cylindric, sometimes tapering downwards, somewhat rugose, whitish, pale orange to ochraceous pink downwards, with a brownish orange tomentose base. *Lamellae* decurrent and extending in longitudinal veins on the stipe, unequal with lamellulae of three lengths, distant, broad (up to 12 mm), thick, white to cream, with brownish spots; edge entire and concolorous. *Context* firm, white; taste mild. *Latex* not abundant, transparent; taste mild. *Spore deposit* white.

Pyrogalic acid: immediately brown. *Aniline*, *Naphthol*, NH_3 , *SF*: nihil. *FeSO₄*: quickly greyish pink. *Guaiac*: intensely blue green. *Phenol*: slowly chocolate brown. *SV*: lamella-trama violently pink, context pink.

Spores: ellipsoid, (7.1)7.7-8.4-9.1-9.9 x 6.0-6.7-7.0-7.6 μm ($Q = 1.08-1.26-1.29-1.43$; $n = 50$); ornamentation amyloid, composed of a partial reticulum; warts connected by irregular connective lines, some isolated, up to 0.5 μm high; plage weakly amyloid. *Basidia* 45-80 x 8-10 μm , cylindric to clavate, 4-spored, slightly thick-walled; content granular. *Macropleurocystidia* abundant, 50-80(100) x 5-7 μm . *Pseudopleurocystidia* scarce. *Lamella-edge* sterile; cheilocystidia 15-37 x 4-7 μm , cylindric, tapering or obtuse, often septate, thick-walled (up to 1.0 μm). *Lamella-trama* composed of sphaerocytes; lactiferous hyphae present. *Pileipellis* two-layered; elements of the suprapellis 30-60 x 5-7 μm , regularly cylindric, obtuse, thick-walled (1-2 μm); subpellis pseudoparenchymatous, spherical cells 10(20) μm , with slightly thickened wall. *Stipitipellis* two-layered; elements of the suprapellis 20-60 x 5-10 μm , cylindric, obtuse to slightly tapering upwards, thick-walled

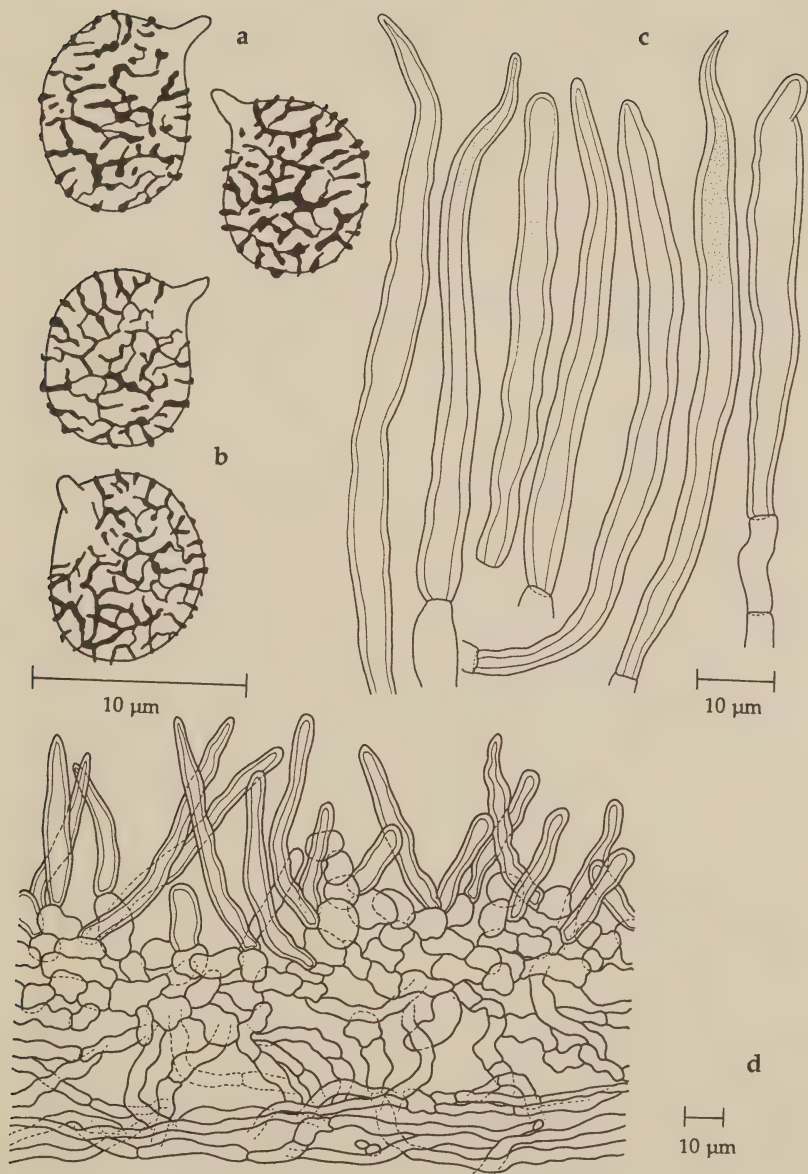


FIG. 4. *Lactarius pseudogymnocarpus* a. Spores (GOOSSENS-FONTANA 899); b. Spores (GOOSSENS-FONTANA 3001); c. Macroleurocystidia (GOOSSENS-FONTANA 899); d. Section through the pileipellis halfway the pileus radius (GOOSSENS-FONTANA 3001).

(1-2 μm); subpellis not distinct, pseudoparenchymatous. *Clamp-connections* absent.

DISTRIBUTION:

Tanzania.— *Lowland rain forest with Macaranga, Piptadenia, Isoberlinia*, on the ground amongst leaf litter: Amani Forest, E. Usambara Mts., Lushoto, Tanga Prov., 04-1968, PEGLER T497 (K).

Zaire.— *Drier Guineo-Congolian rain forest with Macrobium dewevrei*: Binga, Equateur Prov., date unknown, GOOSSENS-FONTANA 899 (holotypus BR); *ibid.*, 06-1942, GOOSSENS-FONTANA 3001 (BR).

OBSERVATIONS

1. The macroscopical description is primarily based on the description of Pegler (1977) completed with notes from GOOSSENS-FONTANA (1955; specimens from Zaire). There is a serious contradiction concerning the taste and smell. PEGLER (1977) describes the taste as "mild" and the smell as "none", while HEIM mentions a "very acrid" taste and "acrid and pepper-like" smell, based on observations made by M^{me} GOOSSENS-FONTANA. Interpreting organoleptic characters noted by GOOSSENS-FONTANA must be done with caution, since her taste was strongly affected by the use of kinin (HEINEMANN, pers. comm.). The macrochemical characters are based on the notes of GOOSSENS-FONTANA. The microscopical description is based on GOOSSENS-FONTANA 899 and GOOSSENS-FONTANA 3001. The spores from PEGLER T497 measure 7.4-8.6-9.7 $\times$ 5.9-6.7-7.5 μm ($Q = 1.17-1.28-1.45$).

2. Coloured illustrations are provided by HEIM (1955a: pl. 13, fig. 1a,c non fig. 1b, = *Lactarius corbula*, VERBEKEN, unpubl.) and HEIM (1955b: pl. 2, fig. 1a,c-e).

3. HEIM (1955) noticed that there are differences in venation of the pileus and taste of context and latex, between what he calls "la forme guinéenne" and the collections of M^{me} GOOSSENS-FONTANA. The remarkable differences in spore-dimensions and pileipellis-structure, however, make it clear that both "forms" concern different species. *L. gymnocarpus* has smaller spores (6.3-7.1-8.2-8.8 $\times$ 5.3-5.9-6.4-7.3 μm) and the elements of the suprapellis of the pileus and the stipe are very irregularly shaped, varying from narrowly cylindric to broadly fusiform or almost rounded, often tortuous, with thickened wall (1-3 μm). *L. pseudo-*

gymnocarpus has longer and wider spores ((7.1)7.7-8.4-9.1-9.9 x 6.0-6.7-7.0-7.6 μm) and the elements of the suprapellis of the pileus and the stipe are regularly cylindric, obtuse, thick-walled (1-2 μm).

6.3. *Lactarius longisporus* nov. sp. - Fig. 5.

Pileus 3-7.5 cm diam., planoconcavus et depressus ad infundibuliformis; margine incurvo ad crenulato; pileipellis aurantia ad griseo-aurantia. *Stipes* 2.5-5 cm longus, 0.8-1.2 cm crassus, cylindratus, albus. *Lamellae* decurrentes, distantes, albo-cremeae ad ochroleucae. *Latex* non abundans, albus, gustu mitis ad amaris. *Sporae* albae in cumulo, 8.4-9.1-11.4-12.5 x 6.1-6.6-7.6-8.4 μm , ellipsoideae ad elongatae, dense reticulatae; macula suprahilaris amyloidea. *Macropleurocystidia* abundantia, (55)70-80(90) x 8-12 μm . *Pileipellis* bistrata; elementa suprapellis (10)35-50(120) x 4-10 μm , cylindrata, tortuosa, interdum ramosa et septata, pariete incrassato (1-2 μm); subpellis pseudoparenchymata.

Pileus 3-7.5 cm diam., quite thick (2.0-4.5 cm), planoconcave and slightly depressed to depressed, infundibuliform when old, irregularly knotty; margin incurved when young, then slightly crenulate and sometimes irregularly grooved when older; pellis not dehiscent, dry, mat, smooth to finely felty, wrinkly to cracked, pale orange to greyish orange (5A4-6AB56), sometimes greyish red to brownish orange. *Stipe* 2.5-5 x 0.8-1.2 cm, cylindric, slender, dry, smooth to very finely filthy, white, chambered to hollow. *Lamellae* decurrent, unequal with lamellulae (3(5) between 2 lamellae, regular pattern), very distant (2+4 to 3+5/cm), medium broad (4-8 mm), thick, very brittle, with remarkable venation when older, white to cream or yellowish; edge entire, concolorous (pale yellow in BB 3583). *Context* firm, white to cream; taste mild to bitter; smell *Cantharellus*-like or absent. *Latex* not abundant, white, unchanging; taste mild to bitter. *Spore deposit* white.

FeSO₄: context salmon pink (sometimes nihil). *HCl*: nihil. *KOH*: cuticula light brown to greyish brown (observed on VERBEKEN 94.520). *NH₄OH*: nihil.

Spores ellipsoid to strongly elongate, 8.4-9.1-11.4-12.5 x 6.1-6.6-7.6-8.4 μm ($Q = 1.22-1.33-1.60-1.80$, $n = 320$); ornamentation amyloid, < 0.1 μm high, composed of a dense and regular reticulum (without isolated warts); plage distinct, amyloid. *Basidia* (48)54-60(80) x (8)9-10.5(12) μm , cylindric to clavate, 4-spored. *Macropleurocystidia* quite abundant, emergent, (55)70-

80(90) x 8-12 µm, cylindric to narrowly fusiform, with slightly thickened wall (to 1 µm); content slightly granular. *Pseudopleurocystidia* present, undistinct, cylindric, sometimes capitate; content oleiferic. *Lamella-edge* fertile. *Lamella-trama* composed of sphaerocytes; lactiferous hyphae present but inconspicuous. *Pileipellis* two-layered; elements of the suprapellis (10)35-50(120) x 4-10 µm, cylindric, tortuous, sometimes branching and septate, thick-walled (1-2 µm); subpellis pseudoparenchymatous, spherical cells (5)10-25(35) µm, thick-walled (0.5-1.5 µm). *Stipitipellis* hyphae interwoven and ascending in suprapellis; spherical cells scarce; terminal elements very tortuous, sometimes with corkscrew curls, 15-45 x 3-4 µm, slightly thick-walled; some terminal elements cylindric, 25-45 x 4-6 µm; slightly thick-walled (< 1 µm). *Clamp-connections* lacking.

ETHNOMYCOLOGICAL NOTES: not eaten by the local populations of Burundi or Zambia.

HABITAT: a typical species from miombo woodland.

DISTRIBUTION: restricted to the miombo woodland of the Zambezian Region (Fig. 2).

Burundi.— *Miombo woodland* dominated by *Brachystegia utilis*: Nyamirambo, near Rumonge, 03-1994, VERBEKEN 94.019, 94.066, 94.078, 94.101, 94.220, 94.277, 94.278, 94.282, 94.348, 94.520, 94.521, 94.522 (BR); *ibid.*, 04-1994, VERBEKEN 94.557 (holotypus BR, isotypus GENT), 12-1993, BUYCK 5234, 5235, 5299, 5300. *Miombo woodland* dominated by *Brachystegia microphylla* and *B. utilis*: Nkayamba, near Rumonge, 12-1992, BUYCK 4675, 4754; *ibid.*, 03-1993, BUYCK 5044, 5057, 5139 (BUYCK).

Zaire.— *Miombo woodland*: Ruashi, 01-1949, SOYER 303 (BR); Kipopo, Shaba, 12-1959, SCHMITZ-LEVEQ 185 (BR).

Zambia.— *Miombo woodland* with *Baphia bequartii*, *Isoberlinia angolensis*, *Uapaca kirkiana*, *Brachystegia spiciformis* and *Albizia antunesiana*: Chati-forest, near Kitwe, Copperbelt, 12-1990, BUYCK 3135, 3136, 3201, 3202, 3209 (BUYCK). *Miombo woodland* with *Uapaca kirkiana* and *Isoberlinia angolensis*: Samfya, Luapala, 12-1990, BUYCK 3256, 3278 (BUYCK). *Miombo woodland* with *Lannea discolor*: Mansa, Kabunda mission, 01-1991, BUYCK 3351 (BUYCK). *Miombo woodland* with *Uapaca kirkiana* and *Brachystegia* sp.: Mwinilunga, road to Solwezi, Western Prov., 01-1991, BUYCK 3510, 3513, 3583 (BUYCK).

OBSERVATIONS

1. The macroscopical description is mainly based on notes from VERBEKEN, completed with notes from BUYCK. The microscopical description is based on BUYCK 5139, 4675, 4754, 3135, 5235.

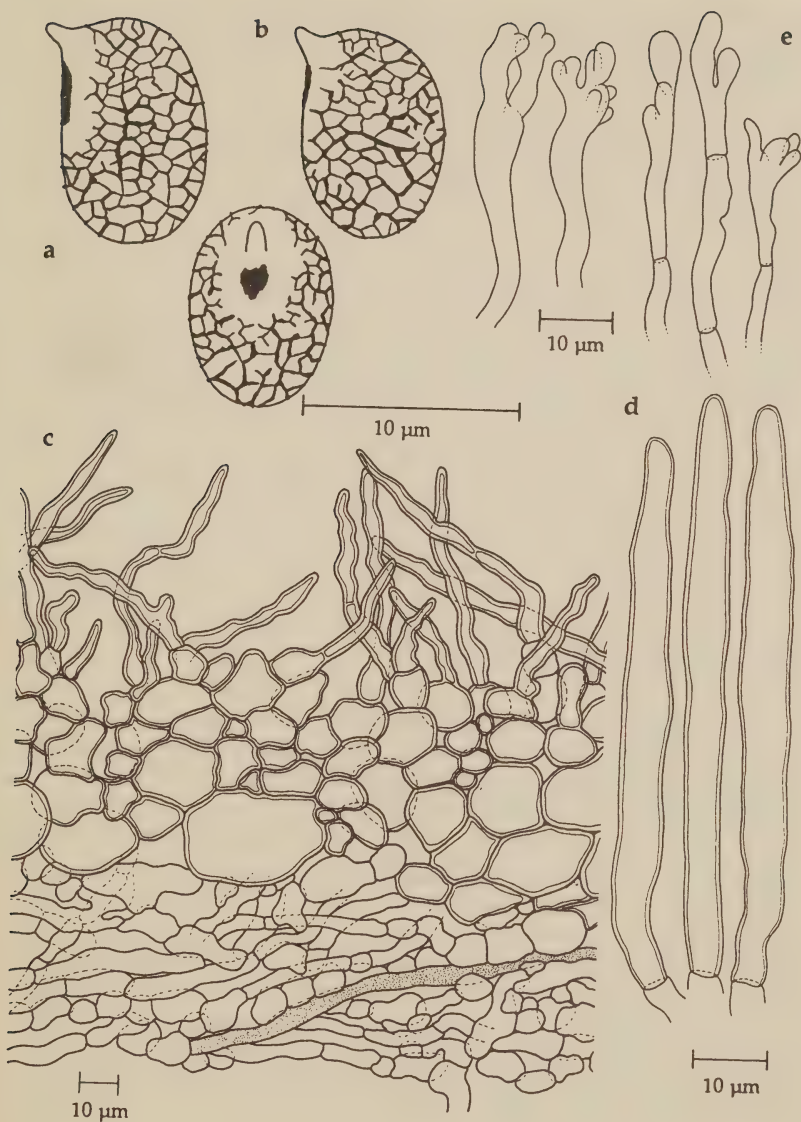


FIG. 5. *Lactarius longisporus* a. Spore (BUYCK 5139); b. Spores (BUYCK 3135); c. Section through the pileipellis halfway the pileus radius (BUYCK 5139); d. Macropleurocystidia (BUYCK 5139); e. Irregularly fingered elements in the hymenium (BUYCK 3351).

2. The species is best recognized by the orange pileus, contrasting with the white stipe and the elongate spores with the ornamentation composed of a dense reticulum.

3. In some specimens (BUYCK 4754 and BUYCK 3351) small, irregularly fingered elements are observed in the hymenium (Fig. 5). It is not clear whether those are cystidia or deformed basidioles.

6.4. *Lactarius gymnocarpoides* nov. sp. - Fig. 6-7.

Pileus (4)6-9 cm diam., planoconvexus ad leviter depressus et infundibuliformis; margine incurvo ad crenulato et undulato; pileipellis aurantia ad griseo-aurantia. *Stipes* 2.5-6.5 cm longus, 1-2 cm crassus, cylindratus ad fusiformis, basin versus attenuatus, ochroleucus, pallide flavus ad pallide aurantius. *Lamellae* decurrentes, distantes, albo-cremeae ad ochroleucae. *Latex* non abundans, albus, gustu mitis ad astringentis. *Sporae* albae in cumulo, 8.2-8.9-9.3-10.3 x 6.6-7.2-7.9-8.9 μm , ellipsoideae, reticulatae; macula suprahilaris diffuse amyloidea. *Macropleurocystidia* abundantia, fusiformia, 80-130 x 8-12 μm . *Pileipellis* bistrata; elementa suprapellis 20-60 x 5-11 μm , cylindrata, obtusa, pariete incrassato (0.5-1 μm); subpellis pseudoparenchymata.

Pileus (4)6-9 cm diam., quite thick, planoconvex to slightly depressed and infundibuliform; margin incurved when young, then irregular to crenulate and even undulate, sometimes grooved; pellis not dehiscent, dry, smooth to finely felty, wrinkled to cracking, greyish orange to orange when young (6B56), then rather light orange (5AB4-6). *Stipe* 2.5-6.5 x 1-2 cm, cylindric to fusiform, tapering downwards, exceptionally clavate, dry, smooth, yellowish white to light yellow (4A2-5) or light orange (5A3-5), solid to chambered and broadly fistulous. *Lamellae* decurrent, unequal with lamellulae (1 to 3 between 2 lamellae, regular pattern), distant (2+3 to 3+6/cm), medium broad ((3)5-7 mm), thick, brittle, with remarkable venation when older, yellowish white to pale yellow (3A23-4A2-4B4); edge entire, concolorous. *Context* firm, white; taste mild to bitter; smell pleasant. *Latex* not abundant (very abundant in VERBEKEN 94.644), fluid, white, unchanging, mild to astringent. *Spore deposit* white.

FeSO₄: context salmon pink to greyish pink. *HCl*: nihil. *KOH*: cuticula olive green (4C5), context pale yellow. *NH₄OH*: nihil.

Spores ellipsoid, 8.2-8.9-9.3-10.3 x 6.6-7.2-7.9-8.9 μm ($Q = 1.07-1.17-1.27-1.43$; $n = 120$); ornamentation amyloid, forming an almost complete reticulum with quite big meshes, becoming smaller on adaxial side; prominences very low ($< 0.2 \mu\text{m}$); plage diffuse amyloid. *Basidia* 50-70 x 5-13 μm , clavate, 4-spored. *Macropleurocystidia* abundant, 80-130 x 8-12 μm , fusiform, thick-walled (up to 1.5 μm). *Pseudopleurocystidia* abundant, 3-5(7) μm , cylindric, with rounded apex. *Lamella-edge* fertile. *Lamella-trama* composed of sphaerocytes; lactiferous hyphae present but not very conspicuous. *Pileipellis* two-layered; elements of the suprapellis 20-60 x 5-11 μm , regular cylindric, with slightly thickened wall (0.5-1 μm); subpellis pseudoparenchymatous, spherical cells 10-20(30) μm , with slightly thickened wall. *Stipitipellis* composed of densely interwoven hyphae with terminal elements forming a suprapellis; terminal elements 15-30 x 4-8 μm , cylindric, sometimes clavate, thinwalled. *Clamp-connections* absent.

ETHNOMYCOLOGICAL NOTES: not eaten by indigenous populations.

HABITAT: found as well in woodland as in rain forest.

DISTRIBUTION

Burundi.— *Miombo woodland* dominated by *Brachystegia microphylla* and *B. bussei*: Nkayamba, near Rumonge, 03-1994, VERBEKEN 94.149 (BR), 94.150 (holotypus BR, isotypus GENT); *ibid.*, 04-1992, BUYCK 4380 (BUYCK); *ibid.*, 04-1992, BUYCK 4549, 4550, 4551 (BUYCK); *ibid.*, 11-1992, BUYCK 4629, 4630, 4631 (BUYCK); *ibid.*, 12-1992, BUYCK 4747 (BUYCK); *ibid.*, 02-1993, BUYCK 4937 (BUYCK). *Miombo woodland* dominated by *Brachystegia utilis* and *B. bussei*: Nyamirambo, near Rumonge, 03-1994, VERBEKEN 94.397, 94.429, 94.474 (BR). *Woodland* dominated by *Uapaca sansibarica*: Ruvubu, National Park, 04-1994, VERBEKEN 94.644, 94.645, 94.648 (BR).

Guinea.— *Dry coastal forest* with *Anthonota crassifolia*: Lébékéré, Fouta Djallon, 07-1988, THOEN 7966 (THOEN).

Senegal.— *Rain forest*: National Park of Basse Casamance, 09-1986, THOEN s.n.1 (THOEN).

Tanzania.— *Degraded miombo woodland*: Mbalali, 02-1993, SAARIMÄKI 1508 (H).

Zaire.— *Riparian forest*: Shaba, Kanduba, 03-1986, SCHREURS 1529 (BR).

OBSERVATIONS

1. The macroscopical description is based on notes from VERBEKEN and BUYCK. The microscopical description is based on BUYCK 4549, completed with BUYCK 4747 and BUYCK 4380.

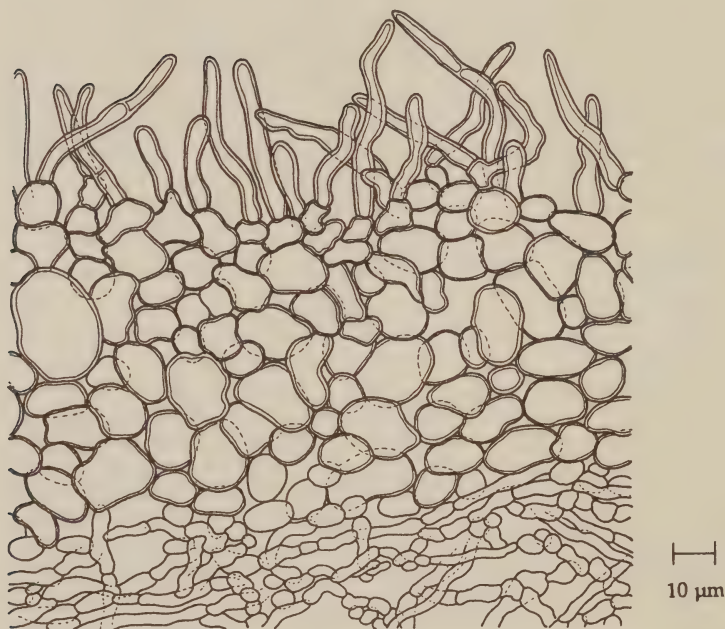


FIG. 6. *Lactarius gymnocarpoides* Section through the pileipellis halfway the pileus radius (BUYCK 4380).

6.5. *Lactarius medusae* nov. sp. - Fig. 7-8.

Pileus 6.3 cm diam., planoconcavus ad depressus; pileipellis velutina, pallide flava ad ochroleuca. *Stipes* 4 cm longus, 1.2 cm crassus, cylindratus, velutinus, aurantio-flavus ad brunneo-aurantius. *Lamellae* subdecurrentes, distantes, brunneo-aurantiae ad pallide brunneae, acie pallidiores, albae.

Sporae 8.2-9.2-10.3 x 6.3-7.1-7.8 μ m, ellipsoideae, dense reticulatae; macula

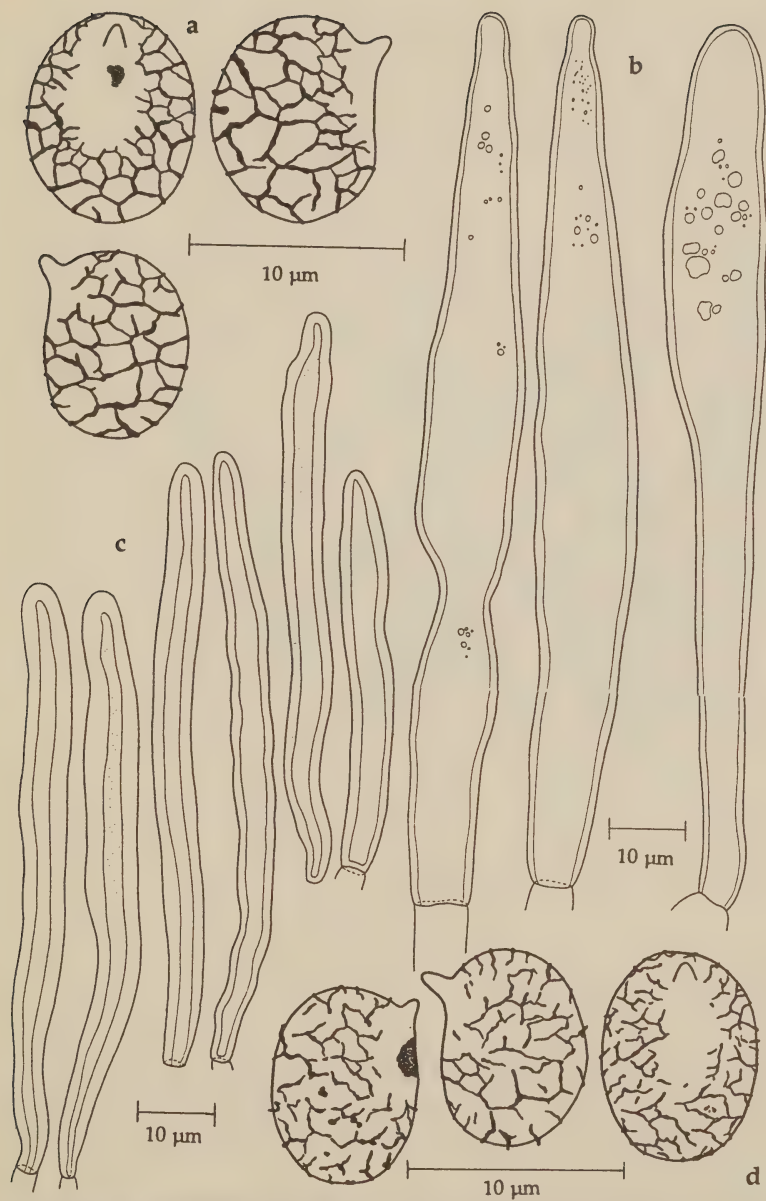


FIG. 7. *Lactarius gymnocarpoides* a. Spores (BUYCK 4747'); b. Macropleurocystidia (BUYCK 4549). *Lactarius medusae* c. Macropleurocystidia (BUYCK 3455); d. Spores (BUYCK 3455).

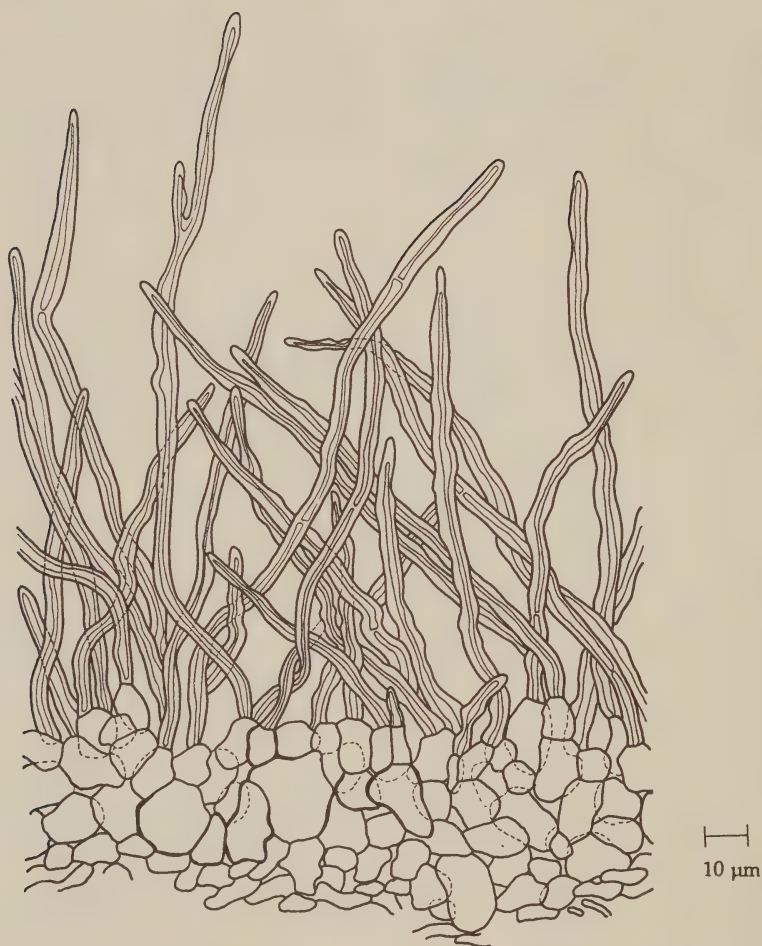


FIG. 8. *Lactarius medusae* Section through the pileipellis halfway the pileus radius (BUYCK 3455).

suprahilaris amyloidea. *Macropleurocystidia* abundantia, cylindrata, 60-80 x 5-6.5 μm . *Pileipellis* bistrata; elementa suprapellis (20)80-250 x 3.5-5.5 μm , cylindrata, angustata, interdum ramosa, pariete incrassato (1-2 μm); subpellis pseudoparenchymata.

EXSICCATUM: *Pileus* 6.3 cm diam., quite thin, planoconcave to slightly depressed; *pellis* velutinous, concentrically wrinkled, pale yellow to yellowish white (4A2-3). *Stipe* 4-1.2 cm, irregularly cylindric, velutinous, reddish blond to brownish orange (5C4). *Lamellae* subdecurrent, distant (4-5/cm), medium broad (3-5 mm), brownish orange to light brown; edge paler, whitish. *Context* brittle, yellowish white.

Spores ellipsoid, $8.2-9.2-10.3 \times 6.3-7.1-7.8 \mu\text{m}$ ($Q = 1.19-1.31-1.42$; $n = 20$); ornamentation amyloid, composed by a complete and dense reticulum; warts never isolated, up to $0.3 \mu\text{m}$ high; connective lines narrow; plage distinct amyloid. *Basidia* $55-65(85) \times 7-9(11) \mu\text{m}$, cylindric to slightly clavate, 4-spored; content granular. *Macropleurocystidia* abundant, emergent up to $35 \mu\text{m}$, $60-80 \times 5-6.5 \mu\text{m}$, cylindric, with thickened wall (up to $2 \mu\text{m}$). *Pseudopleurocystidia* not abundant, $3-5 \mu\text{m}$, cylindric, obtuse. *Lamella-edge* sterile; cheilocystidia $45-70 \times 4-7 \mu\text{m}$, cylindric to slightly clavate; apex obtuse; wall thickened up to $1 \mu\text{m}$. *Lamella-trama* composed of sphaerocytes; lactiferous and oleiferic hyphae abundant. *Pileipellis* two-layered; suprapellis up to $300 \mu\text{m}$, elements of the suprapellis extremely long, $(20) 80-250 \times 3.5-5.5 \mu\text{m}$, regularly cylindric, tapering, sometimes branching, with thickened wall ($1-2 \mu\text{m}$); subpellis pseudoparenchymatous, spherical cells $(5)10-20 \mu\text{m}$, with slightly thickened wall. *Stipitipellis* idem as pileipellis, spherical cells less distinct.

DISTRIBUTION

Zambia.— *Miombo woodland*: near Kawambwa, Luapala, 01-1991, BUYCK 3455 (holotypus BR, isotypus BUYCK).

OBSERVATIONS

1. As notes on the fresh specimen are lacking, the macroscopical description is completely based on the exsiccatum. From the photograph it can be deduced that the surface of the pileus is conspicuously whitish pruinose. The lamellae are yellowish brown in fresh condition. Although the macroscopical data are incomplete, I decided to describe the species because of the very distinct characters in the pilei- and stipitipellis.

2. Small, irregularly fingered elements are observed in the hymenium. It is not clear whether those are cystidia or deformed basidioles.

6.6. *Lactarius luteopus* nov. sp. - Fig. 9.

Pileus 2-6(10) cm diam., planoconvexus et leviter depressus ad infundibuliformis, interdum mammosus in centro; margine subtile incurvo ad crenulato et undulato; pileipellis pallide flava, aurantio-flava ad aurantia, marginem versus pallidior. *Stipes* 1-3.5(4.5) cm longus, 0.6-1.5(2) cm crassus, breve cylindricus, basin versus attenuatus, distincte flavus. *Lamellae* decurrentes, distantes, flavae ad albo-flavae. *Latex* non abundans, albus, gustu mitis. *Sporae* albae in cumulo, 7.3-8.3-8.9-9.9 x 5.8-6.3-6.7-7.3 μm , ellipsoideae ad elongatae, irregulariter reticulatae; macula suprahilaris amyloidea. *Macropleurocystidia* rara, cylindrica ad subtile fusiformia, septata, 55-70 x 7-10 μm . *Pileipellis* bistrata; elementa suprapellis 15-70 x 3-6 μm , cylindrica, leviter angustata, interdum ramosa et septata, pariete leviter incrassato; subpellis pseudoparenchymata.

Pileus: 2-6(10) cm diam., rather thin (1-3 mm), planoconvex and slightly depressed to infundibuliform and irregularly so, sometimes with a small papilla; margin slightly incurved when young, then irregular to crenulate and even undulate; pellis not dehiscent, dry, smooth, finely wrinkled, especially towards the margin, sometimes cracking, light yellow to orange yellow (3A45, 4A4-8) or deep orange to greyish orange (5A6, 5B56); margin paler yellow when young. *Stipe* 1-3.5(4.5) x 0.6-1.5(2) cm, shortly cylindric, often tapering downwards, dry, smooth, vivid yellow (23A78) to greenish yellow (1A78), when paler then always yellow at the base, firm, then fistulous. *Lamellae* decurrent, unequal with lamellulae (1 to 3 between 2 lamellae, regular pattern), distant (2+3 to 5+15/cm), medium broad (4-7(11) mm), thick, very brittle, with remarkable venation when older, vivid yellow when young (4A8), rather light yellow (4A4) or pale orange (5A5) to even yellowish white (3A2) when older; edge entire, concolorous. *Context* fragile, white, but vivid yellow around the cavities in the stipe; taste mild, pleasant; smell pleasant, *Cantharellus*-like. *Latex* not abundant, white, unchanging, mild. *Spore deposit* white.

FeSO₄: context immediately orange or faintly so. *HCl*, *KOH*, *NH₄OH*: nihil.

Spores ellipsoid to elongate, 7.3-8.3-8.9-9.9 x 5.8-6.3-6.7-7.3 μm ($Q = 1.17-1.26-1.41-1.55$; $n = 180$); ornamentation amyloid, forming an incomplete to almost complete, but irregular reticulum; isolated warts also present but rare; prominences very low ($< 0.2 \mu\text{m}$); plage amyloid in centre. *Basidia* 45-60 x 7-10 μm , cylindric, (2)4-spored. *Macropleurocystidia* very

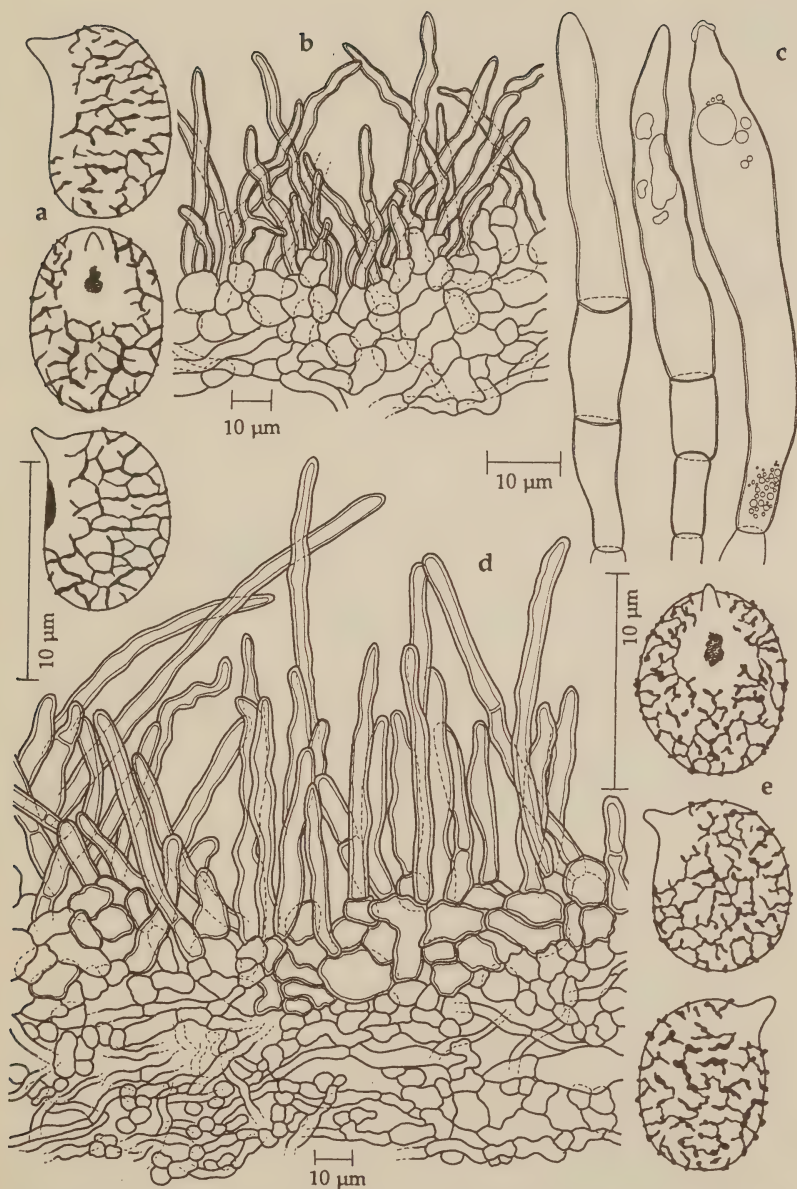


FIG. 9. *Lactarius luteopus* a. Spores (BUYCK 3281); b. Section through the pileipellis halfway the pileus radius (RAMMELOO 5785); c. Macropleurocystidia (BUYCK 3281). *Lactarius flammans* d. Section through the pileipellis halfway the pileus radius (BUYCK 3492); e. Spores (BUYCK 3492).

scarce, not very emergent, cylindric to narrowly fusiform, often septate, 55-70 x 7-10 μm , wall slightly thickened; content granular. *Pseudopleurocystidia* not abundant, 3-5 μm , cylindric, obtuse. *Lamella-edge* fertile. *Lamellatrama* composed of sphaerocytes; lactiferous hyphae present but not very conspicuous. *Pileipellis* two-layered; elements of the suprapellis 15-70 x 3-6 μm , cylindric, sometimes branching, sometimes septate, slightly tapering, densely interwoven, with slightly thickened wall, subpellis pseudoparenchymatous. *Stipitipellis* two-layered; elements of the suprapellis 25-55 x 4-8 μm , cylindric, sometimes slightly clavate, thick-walled (up to 1.5 μm), subpellis pseudoparenchymatous. *Clamp-connections* absent.

ETHNOMYCOLOGICAL NOTES: not eaten by the local populations of Burundi or Zambia.

HABITAT: a typical species of miombo woodlands.

DISTRIBUTION:

Burundi.— *Miombo woodland* dominated by *Brachystegia utilis* and *B. bussei*: Nyamirambo, near Rumonge, 03-1994, VERBEKEN 94.347, 94.428 (BR), 94.463 (holotypus BR, isotypus GENT), 94.464 (BR). *Miombo woodland* dominated by *Brachystegia microphylla* and *B. bussei*: Nkayamba, near Rumonge, 12-1992, BUYCK 4807 (BUYCK). *Brachystegia-forest*: Mugara, Bururi Prov., 11-1978, RAMMELOO 5785 (BR).

Tanzania.— *Woodland* with *Uapaca* sp.: Southern Prov., Songea district, Mawa, 01.1993, SAARIMÄKI ET AL. 1415, 1424 (H). *Woodland* with *Uapaca* sp., *Faurea* sp. and *Parinari* sp.: Southern Prov., Songea district, Hanga, Nyamagoma, 01.1993, SAARIMÄKI ET AL. 1432 (H). *Degraded woodland* with *Brachystegia* sp., *Uapaca* sp., *Ochna* sp., *Parinari* sp., *Rothmannia* sp., *Combretum molle*, *Garcinia* sp., *Gardenia* sp.: Southern Highlands Prov., Njombe district, Ngaramira, 01.1993, SAARIMÄKI ET AL. 1486 (H).

Zambia.— *Woodland* with *Uapaca kirkiana*, *Uapaca nitida*: Samfya, Luapala, 12-1990, BUYCK 3252, 3270, 3272, 3281, 3282, 3285 (BUYCK). *Woodland* with *Uapaca kirkiana*: Mansa, Kabunda mission, 12-1990, BUYCK 3286, 3287 (BUYCK).

OBSERVATIONS

1. Macroscopical description was based on field-notes from BUYCK en VERBEKEN. Microscopical description was based on BUYCK 3281 and 3286.

2. A 5-spored basidium was observed in BUYCK 3281.

3. In one specimen (JR 5785), small, irregularly fingered elements are observed in the hymenium. It is not clear whether those are cystidia or deformed basidioles.

4. The species is best recognized by the vivid yellow stipe and vivid yellow young lamellae.

6.7. *Lactarius flammans* nov. sp. - Fig. 9.

Pileus 4-8 cm diam., planoconvexus ad planus et depressus; pileipellis aurantia, pallidior in centro, margine flavo ad cremeo. *Stipes* 2-3.5 cm longus, 1-2 cm crassus, cylindricus, basin versus attenuatus, aurantius, basin versus pallidior. *Sporae* albae in cumulo, 6.5-7.3-8.4-9.3 x 4.9-5.5-6.0-6.5 μm , ellipsoideae, interdum elongatae, irregulariter verrucoso-reticulatae; macula suprahilaris interdum leviter amyloidea. *Macroleurocystidia* absentia. *Pileipellis* bistrata; elementa suprapellis 30-80 x 4-7 μm , cylindrata ad leviter tortuosa, obtusa, interdum septata, pariete incrassato (0.5-1 μm); subpellis pseudoparenchymata.

Pileus 4-8 cm diam., firm, solid, planoconvex to applanate and depressed, irregularly wrinkled; pellis not dehiscent, wrinkling concentrically, mat, smooth, deep orange (5A78, 6AB78), becoming paler in the centre when older; margin always remarkably yellowish to cream. *Stipe* 2-3.5 x 1-2 cm, cylindric to tapering downwards, firm, smooth, deep orange (5A78, 6AB78), but paler towards the base. *Lamellae* decurrent, unequal with lamellulae (1 to 3 between 2 lamellae), distant (3+2/cm), medium broad (2-4(6) mm), pale. *Context* white. *Latex* not noticed. *Spore deposit* white.

Spores ellipsoid, sometimes elongate, 6.5-7.3-8.4-9.3 x 4.9-5.5-6.0-6.5 μm ($Q = 1.20-1.32-1.39-1.50$; $n = 60$); ornamentation amyloid, forming an incomplete and irregular reticulum with distinct and sometimes also isolated warts; ridges irregular, some very fine; prominences low ($< 0.5 \mu\text{m}$); plage sometimes faintly amyloid. *Basidia* 50-65 x 8-10 μm , cylindric to slightly clavate, 4-spored. *Macroleurocystidia* not observed. *Pseudopleurocystidia* abundant, 4-8 μm , cylindric to tortuous, obtuse, moniliform or irregular on top; content granular to oleiferic. *Lamella-edge* sterile; cheilocystidia 25-50 x 3-5 μm , cylindric to fusiform, obtuse, often septate, with slightly thickened wall. *Lamella-trama* composed of sphaerocytes; lactiferous hyphae abundant. *Pileipellis* two-layered; elements of the suprapellis 35-130 x 4-5(7) μm , cylindric to slightly tortuous, obtuse, sometimes septate, thick-walled (up to

1 μm); subpellis pseudoparenchymatous, spherical cells 5-15 μm , slightly thick-walled. *Stipitipellis* two-layered; elements of the suprapellis 30-80 x 4-7 μm , cylindric to tortuous, obtuse or tapering upwards, thick-walled (up to 1.5 μm); subpellis not distinct, pseudoparenchymatous. *Clamp-connections* absent.

DISTRIBUTION:

Zambia.— Woodland with *Julbernardia globiflora* and *Marquesia* sp.: near Kawambwa, Luapala Prov., 01-1991, BUYCK 3436, 3437 (BUYCK). *Miombo woodland*: Mwekera-forest, near Kitwe, Copperbelt Prov., 01-1991, BUYCK 3492 (holotypus BR, isotypus BUYCK).

OBSERVATIONS

1. The description is based on BUYCK 3437, completed with BUYCK 3492 for the microscopical description.

6.8. *Lactarius* sp.1.

Lactarius goossensiae BEELI p.p., Bull. Soc. Roy. Bot. Belgique **60**: 165 (1928).

Pileus convex to infundibuliform, thin, brownish orange. *Stipe* firm, yellowish orange. *Lamellae* adnate to decurrent, cream. *Context* firm, taste acrid. *Spore deposit* white.

Spores (7.9)8.2-9.1-10.3 x 5.2-5.8-6.3, elongate to extremely elongate ($Q = 1.38-1.57-1.75$, $n = 20$); ornamentation an incomplete reticulum with distinct warts. *Pseudopleurocystidia* quite abundant, very emergent, cylindric to flexuose, obtuse to tapering, 7-15 μm diam. *Macropleurocystidia* absent. *Lamella-trama* composed of sphaerocytes; lactiferous hyphae present. *Pileipellis* two-layered; elements of the suprapellis 10-45 x 4-6 μm , narrow cylindric, thick-walled (up to 1 μm); subpellis pseudoparenchymatous. *Stipitipellis* two-layered; elements of the suprapellis 10-45 x 4-6 μm , narrow cylindric, thick-walled (up to 1 μm); subpellis pseudoparenchymatous. *Clamp-connections* absent.

VERNACULAR NAME: Nsesenge (Zaire).

DISTRIBUTION:

Zaire.— *Swamp forest*: Eala, Equateur Prov., 07-1923, GOOSSENS-FONTANA 268 (BR) .

6.9. *Lactarius* sp.2.

Pileus 6-13 diam., convex to slightly depressed; edge wavy and uneven; pellis bright orange. *Stipe* 3-8 x 1.5-3 cm, cylindric, striate, white or cream; damaged areas turning brown. *Lamellae* decurrent, cream with brown spots, fairly thick, 7 mm broad, spaced with several lamellulae, 5-8 L+1/cm. *Context* white, hard, brittle; smell faintly like *Russula xerampelina*; taste mild. *Latex* white.

Spores 6.9-7.4-8.0 x 5.2-5.8-6.3 μm , ellipsoid ($Q = 1.19-1.28-1.37$, $n = 20$); ornamentation very fine with small warts and few fine connective lines; plage not amyloid. *Basidia* 60-65 x 7-8 μm , cylindric to slightly clavate, 4-spored, often thick-walled at the base. *Pseudopleurocystidia* not abundant, 3-5 μm , cylindric, obtuse. *Macropoleurocystidia* absent. *Lamella-edge* sterile; cheilocystidia cylindric and obtuse to tapering and almost pointed. *Lamella-trama* composed of sphaerocytes; lactiferous hyphae present. *Pileipellis* two-layered; elements of the suprapellis 20-100 x 5-10 μm , clavate to irregularly cylindric, some narrow cylindric, often branched, thick-walled (1-3 μm); subpellis pseudoparenchymatous, spherical cells 10-25 μm diam. *Stipitipellis* two-layered; elements of the suprapellis 30-45 x 8-10(15) μm , broadly clavate to lanceolate and cylindric, thick-walled; subpellis pseudoparenchymatous. *Clamp-connections* absent.

ETHNOMYCOLOGICAL NOTES: inedible (Ngindo); edible after boiling and cooking (Makonde).

DISTRIBUTION

Tanzania.— *Miombo woodland*: Marryi, 01-1993, SAARIMÄKI ET AL. 1277 (H) .

OBSERVATIONS

1. The specimen seems to be very close to *L. gymnocarpus* but differs from it by the white or whitish stipe and the clearly denser lamellae. The elements from the suprapellis of the pileipellis are less irregular than those of *L. gymnocarpus*. This could be a new taxon; for lack of more material and more complete data, it is not described yet.

7. ACKNOWLEDGEMENTS

I wish to express my gratitude to the directors and curators of the Herbaria referred to above, to Bart Buyck and Daniel Thoen who kindly lent me their private collection, to Bart Buyck and Jan Rammeloo for reviewing this paper, to Paul Goetghebeur for checking and improving the Latin description, to Ruben Walley, Paul Van der Veken and Vincent Demoulin for the critical remarks and useful comments, to Cassien Niyondiko and Bart Buyck for the field assistance and to Alain Empain for the technical realisation of the distribution map. The National Foundation for Scientific Research (N.F.W.O., Belgium) is acknowledged for founding this research and for the financial support of my collecting-trip to Burundi.

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MYCOTAXON

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***Phanerochaete parvispora* sp. nov. (Aphyllophorales) from Venetian Lagoon, Italy**

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Summary

Phanerochaete parvispora S.H. Wu & Losi is described as a new species from Venetian Lagoon, Italy. This species is characterized by its small basidiospores and the lack of cystidia.

Phanerochaete parvispora S.H. Wu & Losi, sp. nov. (Fig. 1)

Basidiocarpum effusum, membranaceum, 40-120 μm crassum; superficies hymenialis nivea, plana. Systema hypharum monomiticum; hyphae efibulatae. Cystidia desunt. Basidia subclavata vel anguste clavata, 4 sterigmatibus, 18-32 x 4.0-5.5 μm . Basidiosporae ellipsoideae, laeves, tenuitunicatae, 3.2-4.2 x 2.2-2.8 μm , IKI-, CB-.

Holotypus: Italy. Venice Lagoon, Ca Savio, m, on *Alnus glutinosa*, coll. Losi, 9.V.1992 (Venice Museum 312; isotypus: National Museum of Natural Science, ROC).

Etymology: From parvus (= small) + sporus (= spore), referring to the dimensions of the basidiospores.

Fruit body resupinate, effuse, adnate, membranaceous, 40-120 μm thick in section. Hymenial surface whitish, smooth, sometimes cracked; margin concolorous, thinning, not clearly differentiated or arachnoid.

Hyphal system monomitic; hyphae simple-septate. Subiculum thin, fairly uniform, with dense texture; hyphae hyaline, $\pm$ horizontal, fairly distinct, 2-4 μm diam, thin-walled.

Subhymenium distinctly thickening, usually represents main part of fruit body, looser in texture than that of subiculum, not clearly differentiated from subiculum; hyphae hyaline, $\pm$ vertical, $1.5-3.5\ \mu\text{m}$ diam, thin-walled. Cystidia lacking. Basidia subclavate or narrowly clavate, $18-32 \times 4.0-5.5\ \mu\text{m}$, 4-sterigmate. Basidiospores ellipsoid or broadly ellipsoid, adaxially slightly concave, smooth, thin-walled, with small oil-drops, $3.2-4.2 \times 2.2-2.8\ \mu\text{m}$, IKI-, CB-.

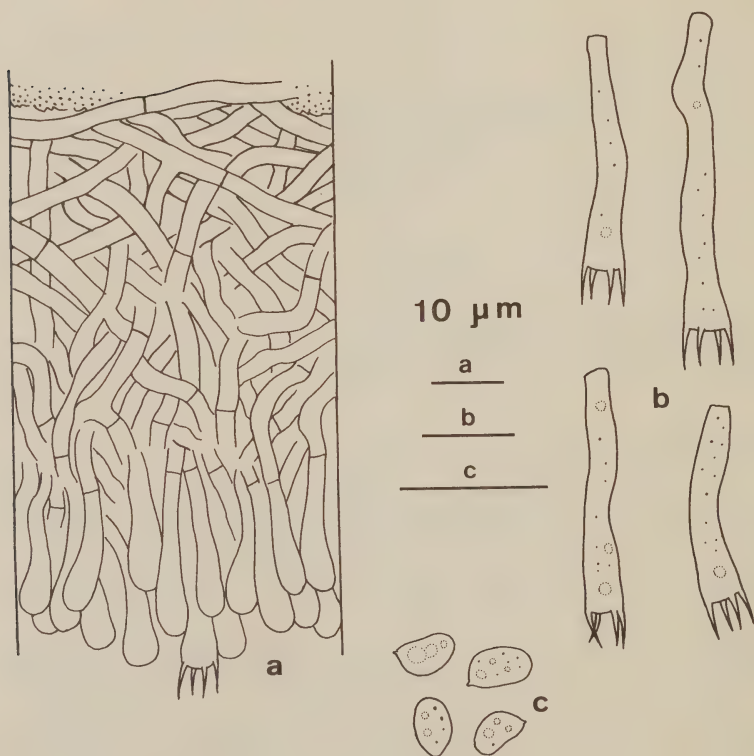


Fig. 1. *Phanerochaete parvispora* (holotype). a) Fruit body section, b) basidia, c) basidiospores.

Specimen examined: Italy (see type).

Distribution: Known only from Italy.

Remarks: Diagnostic features of *P. parvispora* are the absence of cystidia and the small basidiospores. *P. galactites* (Bourd. & Galz.) Erikss. & Ryv., although similar in these respects, differs from this new species in having longer basidiospores (4.5-5.5 (-6) μm), and much looser subiculum (according to Eriksson et al. 1978 and Burdsall 1985).

Acknowledgements

The authors are indebted to Drs J. Boidin and N. Hallenberg for suggestions on this new taxon.

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HYPOXYLON RAVIDOROSEUM AND *NEMANIA IMMERSIDISCUS*, TWO NEW SPECIES FROM THE HAWAIIAN ISLANDS AND PAPUA NEW GUINEA

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ABSTRACT

Hypoxylon ravidoroseum and *Nemania immersidiscus* are described as new species that occur in the Hawaiian Islands and Papua New Guinea.

KEY WORDS: Hawaiian Islands, *Hypoxylon*, *Nemania*, Papua New Guinea

Two of us (Ju and Rogers) have been investigating xylariaceous fungi on a worldwide basis; Van der Gucht has completed a study of the Xylariaceae of Papua New Guinea. In comparing specimens it became evident that two new taxa occur in two locations---the Hawaiian Islands and Papua New Guinea. It was thus most efficient to publish them here. The finding of these new and perhaps rare fungi in these two widely separated archipelagoes raises some interesting questions of fungal evolution and distribution in the Pacific.

Hypoxylon ravidoroseum Y.-M. Ju, Van der Gucht, et J. D. Rogers

Plate 1; Plate 3, E and F

Stromata effuso-pulvinata, levia, (0.5-) 1-5 cm longa x (0.3-) 0.5-3 cm lata x 0.4-0.6 mm crassa; externe

griseo-rosea, vinoso-livida, vel subvinosa, sub superficie et inter perithecia granulis caryophyllaceis conspersa, granulis incoloratis in KOH dissolutis; textura sub peritheciis inconspicua. Perithecia obovata, 0.1-0.2 mm diam x 0.2-0.3 mm alta. Ostiola umbilicata. Asci 87-105 μm longitudine tota x 3-5 μm crassi, partibus sporiferis 43-52 μm longitudine, stipitibus 41-55 μm longitudine, annulo apicali in liquore Melzeri cyanescente, discoideo, 0.3-0.5 μm alto x 1 μm lato. Ascosporae brunneolae vel brunneae, unicellulares, ellipsoideo-inequilaterales apicibus angustatis, 5-7 x 2.5-3.5 μm , rima germinativa recta dorsali longa praeditae; perisporium in KOH dehiscens; episporium leve. Status anamorphicus: Nodulisporio simili.

Stromata effused-pulvinate, plane, (0.5-) 1-5 cm long x (0.3-) 0.5-3 cm broad x 0.4-0.6 mm thick; surface grayish rose, livid vinaceous or pale vinaceous; pinkish granules (blackish when integrated) immediately beneath surface and between perithecia, without apparent KOH-extractable pigments; the tissue below the perithecial layer inconspicuous. Perithecia obovate, 0.1-0.2 mm diam x 0.2-0.3 mm high. Ostioles lower than the stromatal surface (umbilicate). Asci 87-105 μm total length x 3-5 μm broad, the spore-bearing parts 43-52 μm long, the stipes 41-55 μm long, with apical ring bluing in Melzer's iodine reagent, discoid, 0.3-0.5 μm high x 1 μm broad. Ascospores light brown to brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 5-7 x 2.5-3.5 μm (avg.: 6.0 x 3.0 μm , 20 spores), with straight germ slit spore-length on the dorsal side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

Colonies on 2% Difco Oatmeal Agar at ca. 20°C and under 12 h fluorescent light never reaching the edge of 9 cm Petri dish, whitish, velvety, azonate, with diffuse margins, with livid vinaceous pigments diffused beyond colonies; reverse dark vinaceous. Sporulating regions restricted at center of colonies, smoke gray to hazel. Conidiophores mononematous, di- or trichotomously branched, with additional branches arising from the first level of conidiogenous regions, light brown, finely roughened, up to 100 μm long x 2.5-3 μm diam. Conidiogenous cells hyaline, finely roughened, 10-19 x 2-2.5 μm . Conidia hyaline, smooth to finely roughened, ellipsoid, with flattened base, 4-5 x 2.5-3 μm .

SPECIMENS EXAMINED: PAPUA NEW GUINEA: Morobe Prov., Lae, 24.X.1989, Van der Gucht, K. 89-1056a, decorticated wood (GENT). U.S.A: Hawaii, MacKenzie State Park,

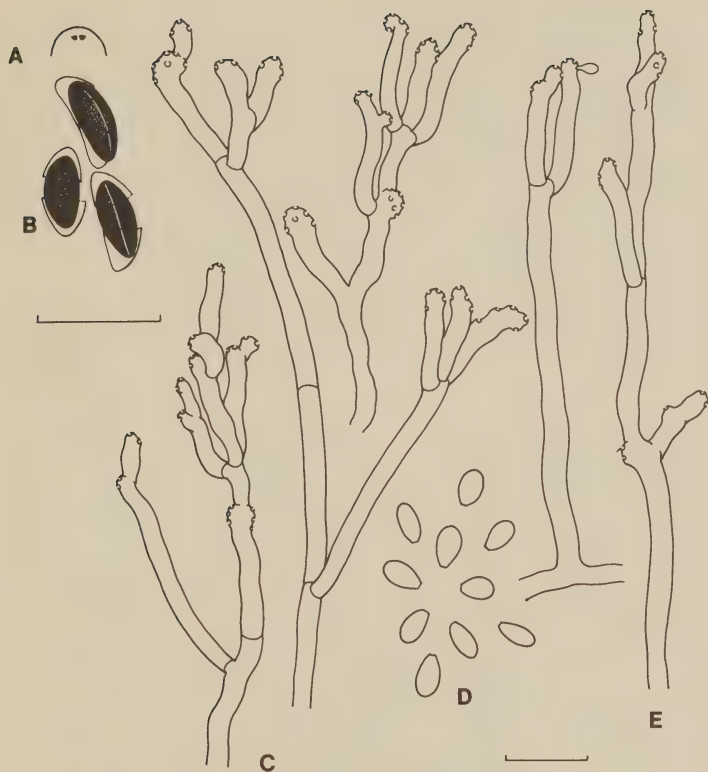


Plate 1. *Hypoxylon ravidoroseum*. A. Ascus apical ring. B. Ascospores showing dehiscent perispore. C. Conidiophores and conidiogenous cells. D. Conidia. E. Conidiophores and conidiogenous cells. Scale bars = 10 μm .

17.VI.1990, Gilbertson, R.L. 16844 (CULTURED), decorticated wood of *Casuarina equisetifolia* (WSP 69610, HOLOTYPE).

NOTES: This fungus is easily recognized by the small ascospore size and the rosy stromatal surface. It belongs to section *Hypoxylon* of Miller (1961). Among the published taxa in the section, only *H. hypomiltum* Mont. var. *microsporum* Abe and *H. ticinense* L. E. Petrini have similar ascospore size ranges. The stromatal surface color of *H. ravidoroseum* is reminiscent of that of *H. fuscopurpureum* (Schwein.: Fr.) M. A. Curtis.

Nemania immersidiscus Van der Gucht, Y.-M. Ju, et J. D. Rogers

Plate 2; Plate 3, A-D

Stromata pulvinata vel effuso-pulvinata, tumulis peritheciis conspicuis, 0.3-6 cm longa x 0.3-3 cm lata x 0.5-1.2 mm crassa; externe fusca vel nigra, sub superficie crusta nitida ca. 0.05 mm crassa praedita plerumque exposita proxima ostiolis; textura inter perithecia albida vel griseola, mollis vel fibrosa; textura sub peritheciis carbonacea tenuis. Perithecia depresso-globosa, (0.4-) 0.6-1 mm diam x 0.6-0.8 mm alta. Ostiola papillata, papillis crustum subsuperficalem penetrantibus et discum immersum 0.1-0.15 (-0.2) mm diam formantes. Asci 110-200 μ m longitudine tota x 6-8 μ m crassi, partibus sporiferis (65-) 75-95 μ m longitudine, stipitibus 70-110 μ m longitudine, annulo apicali in liquore Melzeri cyanescente, urceolato, 2.5-3 μ m alto x 1.5-2.5 μ m lato. Ascosporae fuscae, unicellulares, ellipsoideo-inequilaterales, apicibus angustatis, (10-) 11-14 (-16) x (4-) 4.5-5.5 μ m, rima germinativa recta ventrali longa praeditae.

Status anamorphicus: *Geniculosporium*.

Stromata pulvinate to effused-pulvinate, with perithecial elevations conspicuous, 0.3-6 cm long x 0.3-3 cm broad x 0.5-1.2 mm thick; surface dark grayish brown to black; provided with a polished black crust immediately beneath surface, ca. 0.05 mm thick, usually exposed near ostioles; the tissue between perithecia whitish to grayish, soft to fibrose; the tissue below the perithecial layer carbonous, thin, black. Perithecia depressed-globose, (0.4-) 0.6-1 mm diam x 0.6-0.8 mm high. Ostioles papillate, with the papillae penetrating the subsurface crust and creating sunken discs 0.1-0.15 (-0.2) mm diam. Asci 110-200 μ m total length x 6-8 μ m

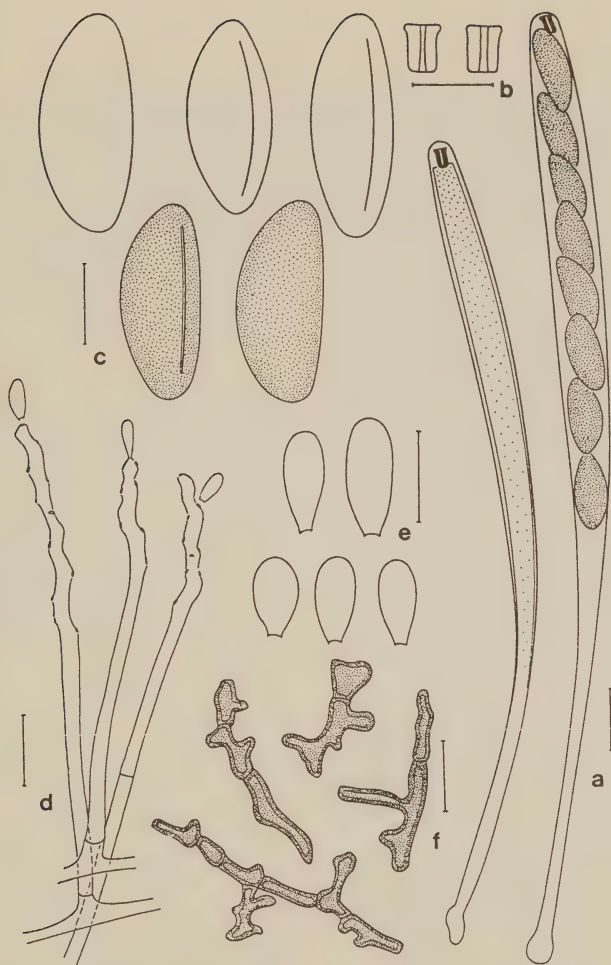


Plate 2. *Nemania immersidiscus*. a. Asci, one of which bears eight ascospores. b. Ascus apical rings. c. Ascospores. d. Conidiophores with conidiogenous cells. e. Conidia. f. Thick-walled brown hyphae with short protuberances formed in aging cultures. Scale bars: b, c, e = 5 μ m; a, d, f = 10 μ m.

broad, the spore-bearing parts (65-) 75-95 μm long, the stipes 70-110 μm long, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 2.5-3 μm high x 1.5-2.5 μm broad. Ascospores dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, (10-) 11-14 (-16) x (4-) 4.5-5.5 μm (avg.: 12.5 x 5 μm , 20 spores), with straight germ slit spore-length or nearly so on ventral side.

Colonies on 2% Difco Malt Extract Agar at ca. 20°C and under 12 h fluorescent light covering 9 cm Petri dish in 3-4 wk, white, felty, with plumose margins and abundant aerial hyphae, sometimes with radiate hyphal strands; black stromatic structures composed of long, thick-walled, brown hyphae with short protuberances formed with age; reverse brown, dark brown to blackish. Sporulating regions scattered over entire surface of colonies, not abundant. Conidiophores mononematous, occasionally dichotomously branched, hyaline, smooth, variable in length, up to 100 μm long x 2-2.5 μm diam. Conidiogenous cells terminal, long cylindrical, geniculate, hyaline, smooth, 40-70 x 2-2.5 μm . Conidia hyaline, smooth, obovoid to ellipsoid, with flattened base, 4.5-6.5 x 2-3 μm (avg.: 5.4 x 2.4 μm , 20 conidia).

Anamorph under natural conditions covering young stromata and contiguous wood as yellowish gray layer. Conidiophores mononematous, dichotomously branched, subhyaline, smooth, up to 100 μm long x 2.5-3 μm diam. Conidiogenous cells terminal, geniculate, subhyaline, smooth, 40-55 x 2 μm . Conidia subhyaline, smooth, obovoid to nearly globose with flattened base, 3-4.5 x 2-3 μm (avg.: 4.0 x 2.3 μm , 20 conidia).

SPECIMENS EXAMINED: PAPUA NEW GUINEA: East Sepik Prov., between Marienberg and Bien, 16.V.1992, Van der Gucht, K. & De Meester, L. 92-985 (CULTURED), dead wood (GENT, HOLOTYPE); Madang Prov., road to Bunapas, 8 km beyond the bifurcation Bogia-Bunapas, 30.X.1989, Van der Gucht, K. & De Meester, L. 89-1312 & 89-1369, dead wood (GENT); Madang Prov., Awar, 20.V.1992, Van der Gucht, K. & De Meester, L. 92-1127 (CULTURED), dead wood (GENT); Madang Prov., Eo loco, 20.V.1992, Van der Gucht, K. & De Meester, L. 92-1134 (CULTURED) & 92-1147a, dead wood (GENT); Madang Prov., Baiteta, 2.VI.1992, Van der Gucht, K. & De Meester, L. 92-1570 (CULTURED) & 92-1572a, dead wood (GENT). U.S.A.: Hawaii, Hanahaia, 27.VIII.1991, Gilbertson, R.L. 17513, wood of *Eucalyptus* (JDR); Hawaii, Hanahaia, 27.VIII.1991, Gilbertson, R.L. 17545 & 17555, wood of *Casuarina* (JDR); Hawaii, Hanahaia, 27.VIII.1991,



Plate 3. *Nemanja immersidiscus* and *Hypoxylon ravidoroseum*. A-D. *N. immersidiscus*. A. Stroma. B. Ostiolar papillae. C. Ostiolar region. D. Culture. E and F. *H. ravidoroseum*. E. Habit of stromata. F. Closeup of stromata showing surface with ostioles. Scale bars: A = 5 mm; B = 400 μ m; C = 50 μ m; D = 1.3 cm; E = 2 cm; F = 625 μ m.

Gilbertson, R.L. 17563 & 17565, wood of *Psidium guajava* (JDR).

NOTES: Petrini and Rogers (1986) did not accept Pouzar's broad concept (1985 a, b) of *Nemania* S. F. Gray. However, we now embrace the genus for selected members of Miller's section *Papillata*, subsection *Primocinerea* of *Hypoxyton* (Miller, 1961). The fungus discussed here greatly resembles *Nemania bipapillata* (Berk. & M. A. Curtis) Pouzar [= *Hypoxyton bipapillatum* Berk. & M. A. Curtis; SURINAM: Exot. Fung. 58, as *Sphaeria colliculosa* by Schweinitz, L.V.D. (PH, HOLOTYPE; K, ISOTYPE of *H. bipapillatum*)], a fungus probably synonymous with *H. subannulatum* Henn. & E. Nyman sensu J. H. Miller, and *H. circostoma* Speg. in having ostiolar discs. *Nemania bipapillata*, however, has more or less raised ostiolar discs, whereas *N. immersidiscus* has a sunken area devoid of stromatal crust surrounding the ostioles. *Hypoxyton circostoma* [CHILE: Los Perales, 1918, Spegazzini, C.L. 1966, wood (BPI, ISOTYPE)] is only known from the type. The interperithecial tissue has disintegrated, but was probably like that of *N. immersidiscus*. It has sunken ostiolar discs ca. 0.3 mm diam and ascospores 15-18 x 7-8 μ m.

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Volume LV, pp. 557-562

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BOOK REVIEWS

D. S. Hibbett, Book Review Editor

A Catalogue of Fungus Plates Painted under the Supervision of Elias Fries, by Åke Strid. Softcover, 215 x 152 mm, 326 pp., 11 figures (9 colored) and 4 tables, 1994. Swedish Museum of Natural History, Department of Cryptogamic Botany, P. O. Box 50007, S-104, 05 Stockholm, Sweden. ISBN 91-86510-33-9. 150.-- SEK including postage.

To commemorate the bicentennial of the birth of Elias Fries (1794-1878), the Swedish Museum of Natural History, Stockholm, has published this catalog. The catalog documents the paintings prepared by a series of artists under Fries's direction beginning in 1845. There were at least 2088 paintings prepared, of which 1789 are extant in the Swedish Museum of Natural History, Stockholm, the Fytoteket in Uppsala and the Royal Botanic Gardens, Kew. In all, 1641 taxa were illustrated. The main body of this book documents these illustrations, providing information on the locality of the illustrated specimen, a unique plate number, date of preparation of the plate, reference to the plates in Fries's works, the artist(s), and remarks and comments. The names used are Fries's; nomenclature and taxonomy have not been updated.

The body of this work is the catalog itself but the introduction is useful and informative; color illustrations of several of the plates, Fries himself, and a landscape add interest. The introduction is biographical in the broadest sense and therefore sets the stage for the production of the plates and their use in several publications. The most notable use of some of them, and perhaps the best known, was in the *Icones selectae Hymenomycetum nondum delineatorum* by Fries (1867-1884) in which 560 species were illustrated in two volumes. The originals, cataloged here, not only represent a number of unpublished plates but also are said in some cases to be more accurate than the published illustrations.

Using the plates and the documentation contained in this catalog, agaricologists and those working with other large basidiomycetes have the opportunity to expand upon the often scant descriptions provided by Fries, and thus they may be aided in the formulation of more accurate concepts of the species he discussed. Certain of the plates may prove

important as nomenclatural types in cases where specimens are lacking (since Fries often did not keep specimens, the importance of the plates is greater than might initially appear). Whatever the case, one could not ask for a better finding aid and study guide than has been presented here. One might, however, ask that entries be consistently in alphabetical order or that an erratum sheet be included to assure that the user does not overlook entries. Alas, the early pages of the index including *Agaricus* species a-c are jumbled although the pages are consecutively numbered. This is an unfortunate occurrence in an otherwise well prepared and presented document.

I used this catalog to seek documentation of a set of plates prepared by Cecilia Berkeley, daughter of the Rev. M. J. Berkeley, which are now housed in the Farlow Library. These were said to be drawn from illustrations provided by Fries upon which I commented (*Mycologia* 84: 911-912, 1992). Some of the illustrations were based on the Fries materials located at Kew as previously noted by R. W. G. Dennis. The Berkeley copies in the Farlow Library are not mentioned by Strid but I was able to determine that Cecilia Berkeley copied plates which are now present in the collection at Uppsala in addition to those at Kew. I was not able to find definitively in the Berkeley copies any of the plates listed among those that have been noted as lost or destroyed by Strid. Interestingly in many cases annotations agree between those listed in the index and those on the Berkeley copies. There are a few cases of taxa that are included in the Berkeley copies that are not found in this catalog but this may be due to name changes on the original plates subsequent to Berkeley having made the copies. Strid points out that many of the plates were copied by Fries's artists and that there is some level of duplication.

This is a handy guide and companion to Fries's published works. Both the author and the Swedish Museum of Natural History have done mycologists a service. *Donald H. Pfister, Farlow Herbarium and Reference Library of Cryptogamic Botany, Harvard University, Cambridge, Massachusetts.*

Tropical Lichens: Their Systematics, Conservation, and Ecology (The Systematics Association Special Volume no. 43), edited by D. J. Galloway. Hardcover, 302 pp., 1991. Oxford University Press, Inc., Business Office, 2001 Evans Road, Cary, NC 27513 (fax 919-677-1303). ISBN 0-19-857720-6. US\$ 120.-

This volume is the result of a conference on tropical lichens held at the Natural History Museum, London, 4-8 September, 1989. The conference was sponsored by the Systematics Association and the International Association for

Lichenology. The book is dedicated to the late Mason E. Hale, a pioneer of tropical lichenology.

The papers are diverse in subject, area of coverage, and length. Each paper adheres to the mandate of the conference, namely to discuss the state of knowledge on conservation, systematics, and ecology of tropical lichens. Twenty-five presentations were made and seventeen of them have been published in this work. Individual contributions include the following: 1) "Biogeographical relationships of Pacific tropical lichen floras." D. J. Galloway states that a palaeotropical macrolichen flora, based on modern concepts of lichen taxonomy, is urgently needed. 2) "The lichen genus *Relicina* in Australasia." J. A. Elix discusses *Relicina*, one of Hale's *Parmelia* segregates, with regard to morphological and chemical evolutionary trends and geographical distribution. Australasia is home for 34 of the 38 known species of this lichen. Chemistry is an important species character and is useful in determining evolutionary direction.

Chemosyndromic variations and divergences are illustrated in some species complexes. 3) "Lichen conservation in Hawaii." C. W. Smith feels that the Hawaiian lichen flora is much less endemic than thought. The richest phorophyte lichen flora is found in cloud forests above 1000 m. Lava flows are quickly colonized by mainly *Stereocaulon* species. Lichen communities in different habitats are outlined. 4) "The tropical Pacific species of *Usnea* and *Ramalina* and their relationships to species in other parts of the world." G. N. Stevens discusses the tropical and temperate origins of maritime and montane species of *Usnea* and *Ramalina* and gives distribution maps of various species complexes. 5) "Evolutionary rates in the Teloschistaceae." I. Karnefelt discusses problems associated with geographical speciation in *Caloplaca*, *Teloschistes*, and *Xanthoria*, mostly from the African flora. Two cladograms support the assumed unnatural relationships between genera in the Teloschistaceae. Karnefelt believes that evolutionary rates among lichenized fungi are slow and some groups may have remained unchanged for millions of years. This view, however, is in contradiction to the molecular findings of Paula DePriest who feels that "genomes of lichen-forming fungi not only can evolve but can evolve rapidly." 6) "Ultrastructure of subtropical crustose lichens." S. C. Tucker, S. W. Matthews, and R. L. Chapman report on the ultrastructure of 13 species of Louisiana lichens, all of them with trentepohliaceous photobionts belonging to the genera *Cephaleuros*, *Phycopeltis* and *Trentepohlia*. Intraparietal haustoria and concentric bodies were present in all lichens. 7) "On the importance of botanical gardens for lichens in the Asian tropics." L.

Arvidsson finds that botanical gardens are important refuges and can serve as genetic banks for lichens. He explores the possibility of transplanting rare and endangered species to such gardens. 8) "Observations on the composition and distribution of the 'Lobarion' in forests of South East Asia." P. A. Wolseley found that one feature of the palaeotropical Lobarion is its high proportion of cyanolichens which allow them to fix nitrogen and photosynthesize at low light intensities. 9) "Spore ontogeny of *Sphaerophorus diplotypus* and *S. fragilis*." M. Wedin observed concentric bodies in young stages of ascospores. He concludes that *Sphaerophorus sensu lato* as presently known is heterogeneous and includes at least two groups that deserve generic rank. 10) "Tropical pyrenocarpous lichens: A phylogenetic approach." A. Aptroot presents a cladistic analysis of pyrenocarpous lichens, which are most diverse in the tropics. These lichens probably have evolved several times from non-lichenized fungi. An appendix gives a key to taxa of pyrenocarpous lichens and related non-lichenized ascomycetes. Five of the remaining chapters concern floristic studies, from Papua New Guinea, Ecuador, the Guianas, Tanzanian montane rainforests, and San Paulo State, Brazil. Finally, two chapters treat foliicolous lichens from Xishuangbanna (southern China) and Tanzania, respectively. In the latter, H. Krog discusses a tree frog mimic which had patches on its back that resembled foliicolous lichens. A curious fact that I have noted about these lichens is that despite their short life cycles and rapid growth rates, none have been isolated into culture, suggesting a high degree of specialization.

Most papers address the dangers facing lichen communities. These include urbanization, tourism, logging and forest clearance, agriculture, mining, fire, and erosion. In an epilogue, T. D. V. Swinscow states, "We are all acutely aware of how tragically uncertain is the future of natural habitats in the tropics, whether from the impact of man's tools locally, or from the influence of climatic changes that he may be bringing about."

Clearly, the papers presented in this volume have furthered our understanding of tropical lichens and lichen communities and will serve as important reference points for future studies. With all the attention being paid nowadays to the destruction and preservation of tropical rainforests, it is important that lichenologists point out that lichens also are an important and still relatively unexplored part of these ecosystems. *Vernon Ahmadjian, Department of Biology, Clark University, Worcester, Massachusetts.*

The Edible Fungi of Africa south of the Sahara: A Literature Survey (Scripta Botanica Belgica, vol 5), by J. Rammeloo and R. Walley. Softcover, 250 x 167 mm, 62 pp., 1993. National Botanic Garden of Belgium, Domein van Bouchout, B-1860 Meise, Belgium. ISBN 90-72619-12-9. BeF 230.-- (+ postage).

The Poisonous and Useful Fungi of Africa south of the Sahara: A Literature Survey (Scripta Botanica Belgica, vol 10), by J. Rammeloo and R. Walley. Softcover, 250 x 167 mm, 56 pp., 1994. National Botanic Garden of Belgium, Domein van Bouchout, B-1860 Meise, Belgium. ISBN 90-72619-12-9. BeF 370.--.

Concern over the ongoing loss of biodiversity has resulted in the genesis of a new biological discipline: conservation biology. Unfortunately, loss of biodiversity is linked to a reduction in human cultural diversity, which includes indigenous knowledge and uses of fungi and plants. Thus, it is timely that the National Botanic Garden of Belgium has published this pair of volumes in which J. Rammeloo and R. Walley seek to document the ethnomycology of southern Africa through a survey of published accounts. These books will be of interest to a diversity of readers, including anthropologists and ethnobotanists, conservationists, pharmaceutical prospectors, and taxonomic mycologists.

The primary purpose of these books is to provide access to the literature, not to aid in identification. Both volumes include introductory chapters on the state of scientific knowledge about African fungi, as well as traditional practices and their regional variations. A list of references is provided in both books, but only vol 10 has a taxonomic index (to both volumes), based on genera. An index to specific epithets would have been useful. The main parts of both volumes are the annotated lists of fungal taxa that are reported to be edible (vol 5), or poisonous, medicinal, or otherwise "useful" (vol 10). Each entry includes the name of the species, the country from which the report was made, a numerical code to the reference(s), and, frequently, additional comments. Despite the bibliographic focus, there is enough information in each entry, especially in the comments, to make the books useful and readable without referring to the literature cited. Every mycologist who picks up these books will immediately want to check what uses have been found in Africa for their favorite fungi. Personally, I was intrigued to learn that the sclerotia of *Pleurotus tuberregium* (as *Lentinus tuberregium*) are used not only as food and medicine, but also to make a base for body paint in parts of Nigeria.

In drawing together the information presented here, the authors were challenged by the fragmentary nature of the literature, as well as the inadequacies of a eurocentric taxonomy for use with African fungi. Authorities have been provided for the species listed, even though they were sometimes missing from the original sources. Unfortunately, there is no indication which names have been thus supplied with authorities, which renders all species designations somewhat suspect. A few minor flaws detract from the presentation, including occasional misspellings and grammatical errors. These are minor quibbles, however. These volumes contain an impressive synthesis of information that will be invaluable for future studies of African ethnomycology. *D.S.H.*

The Fungus Flora of Shetland, by Roy Watling. Softcover, 209 x 295 mm, 98 pp., 1992. Royal Botanic Garden Edinburgh, Print and Publications Section, Inverleith Row, Edinburgh EH3 5LR, United Kingdom. ISBN 1-872291-07-4. £8.--.

Shetland, lying north of mainland Scotland and west of the southern tip of Norway, is, in Roy Watling's words, "generally an undulating system of heather clad hills and valleys bogs and lochs." Weather in Shetland is cool and damp, with relatively little seasonal fluctuation in mean temperatures, but is enlivened by "severe gales with their accompanying high salt-laden winds." This book represents the results of seven years of collecting by the author and his collaborators in the often harsh habitats of Shetland.

Fifteen pages of introductory material describe the geography, climate, plant communities, and previous mycological investigations of Shetland. Several maps show collecting locations, as well as the distribution of beds of *Salix repens*, which are said to harbor an interesting group of ectomycorrhizal fungi. The bulk of the book consists of a checklist. All groups of fungi, in the broadest sense, are treated, including "Phycomycetes" (43 species) and Myxomycetes (21 species), but the emphasis is clearly on Basidiomycetes (496 species), Ascomycetes (239 species), and Deuteromycetes (190 species). Almost all entries include reference(s) to the literature cited and notes on collection localities. There are no keys. This book would be easier to use if any of the following had been provided: an index; a table of contents; or, a detailed overview of the taxonomic system employed. Nevertheless, this inexpensive volume is clearly an essential reference for mycologists working in Shetland (as well as the Faeroes, Hebrides, *etc*) and a valuable contribution to fungal biogeography of the northern hemisphere. *D.S.H.*

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